OCR A-LEVEL BIOLOGY A

BIOLOGY



EXAM QUESTION PACK

UNIT F212 OLD SPECIFICATION PAPERS

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OCR
Oxford Cambridge and RSA

Tuesday 7 June 2016 – Afternoon

AS GCE BIOLOGY

F212/01 Molecules, Biodiversity, Food and Health

Candidates answer on the Question Paper.

OCR supplied materials:
None

Other materials required:
- Electronic calculator
- Ruler (cm/mm)

Duration: 1 hour 45 minutes

F212/01

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined pages at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **100**.
- Where you see this icon, you will be awarded marks for the quality of written communication in your answer.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.
- This document consists of **24** pages. Any blank pages are indicated.

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Answer **all** the questions.

1 In cells, glucose can exist as α-glucose or as β-glucose.

(a) Fig. 1.1 represents the structural formula of a molecule of α-glucose.

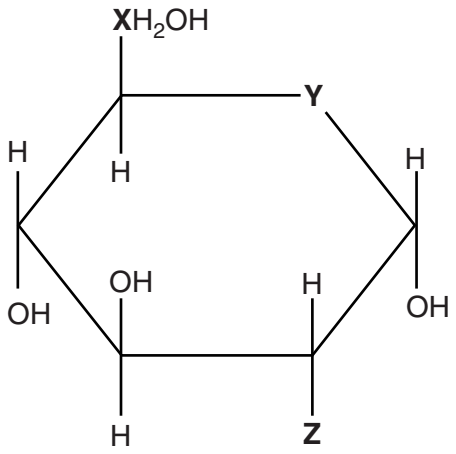


Fig. 1.1

(i) In Fig. 1.1 some atoms or groups have been replaced by the letters **X**, **Y** and **Z**.

Identify the correct atom or group that has been replaced by each letter.

X .....

Y .....

Z .....

[3]

(ii) Describe how the structure drawn in Fig. 1.1 above would be different if it represented a molecule of **β-glucose**.

.....

..... **[2]**

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(iii) Two α-glucose molecules can be joined to form a disaccharide molecule.

State the **precise** name of the covalent bond that forms between the two glucose molecules and the name of the disaccharide that is formed.

bond ....

disaccharide ....
[2]

(b) Glucose, glycogen and amylose are carbohydrates.

- Glycogen and amylose are used for energy storage.
- Glycogen is found in animals.
- Amylose is found in plants.

Describe how the structure of glycogen allows it to perform its function **and** explain the advantage to animals of using glycogen as an energy store.

In your answer you should make clear the links between structure and function.

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.... **[7]**

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(c) Alpha (α) and beta (β) are prefixes that are frequently used to describe a range of biological molecules, such as α-glucose and β-glucose.

The prefixes α and β can also be used when describing protein structure.

Complete the following statements about proteins using the most appropriate terms.

- The secondary structure of a protein may contain many regions folded in zig-zag patterns known as ..... .
- The secondary structure of a protein is determined by the arrangement of ..... bonds, which stabilise the structure.
- The ..... structure of collagen is described as a left-handed helix because of the direction in which the polypeptide twists.
- Polypeptides known as alpha (α) and beta (β) ..... form part of the ..... structure of haemoglobin. **[5]**

[Total: 19]

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2 Influenza (flu) is a disease that affects millions of people worldwide. Many vulnerable people receive vaccinations against flu each year.

(a) A flu vaccination consists of a suspension of antigenic material from the flu virus, which is then injected into patients.

Tick the box that best describes the type of immunity provided by the flu vaccination.

active and natural	
active and artificial	
passive and natural	
passive and artificial	

[1]

(b) Fig. 2.1 represents an influenza virus. Various protein antigens are attached to the outer surface of the virus.

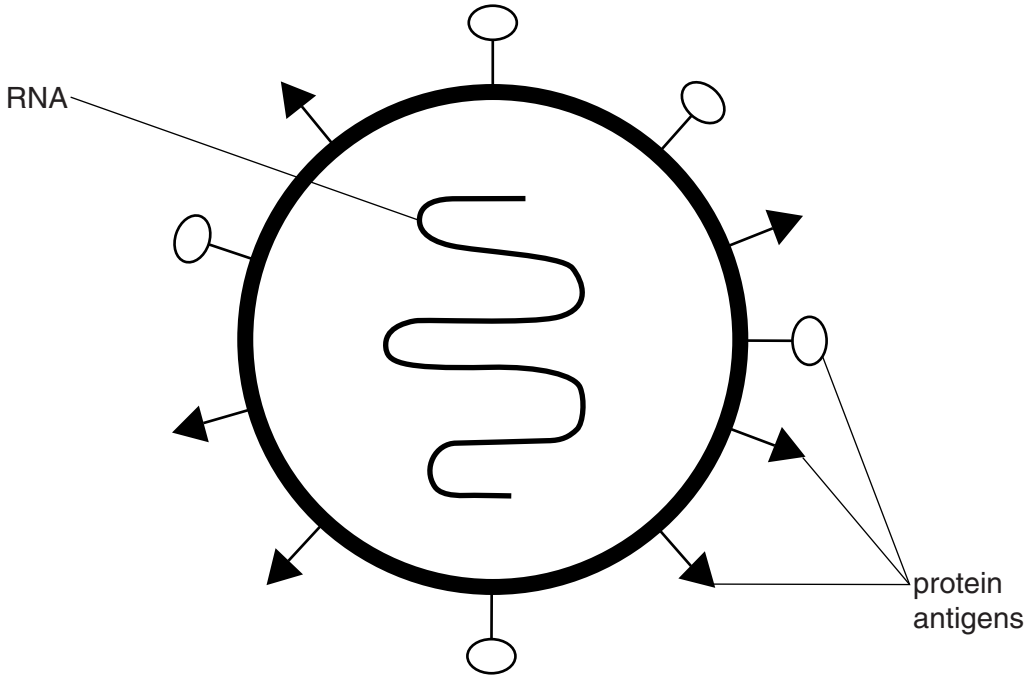


Fig. 2.1

When a virus infects a human host, it causes the host's cells to produce many new copies of the virus.

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(i) The flu vaccination must be given each year because there are frequent mutations in the RNA of the virus.

The antigens on the surface of the virus are made of protein.

The virus uses the organelles and enzymes in the host's cells to produce new copies of itself.

Suggest the role of the viral RNA in the production of viral proteins.

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..... **[2]**

(ii) Explain why a mutation in the viral RNA leads to a change in the 3-D shape of the protein antigens.

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..... **[3]**

(iii) The head teacher of a school decided to offer teachers free flu vaccinations every year.

Suggest why the head teacher thought this would be a good use of the school's money.

.....

..... **[1]**

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(c) Compare the primary and secondary immune response by filling in the table below.

	Primary response	**Secondary response**
Relative concentration of antibodies produced		
Relative duration of response		

[2]

(d) Name **two different** types of T-lymphocytes **and** describe their roles in the immune response.

1 .....

.....

2 .....

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[2]

[Total: 11]

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3 Enzymes are important molecules in living organisms.

(a) (i) A student decided to use the biuret test to detect the presence of enzyme in a solution.

Outline the procedure the student should follow in order to detect the presence of enzyme in a solution using the biuret test.

.....

.....

..... **[2]**

(ii) State why the structure of enzyme molecules allows them to be detected **in solution** using the biuret test.

.....

..... **[1]**

(b) The student wished to determine the mass of enzyme in 250 cm^3 of an enzyme solution of unknown concentration.

To determine the concentration of this enzyme solution, the student first carried out the biuret test on three enzyme solutions of known concentration:

- solution **1** 0.5 $mg\,cm^{-3}$ of enzyme
- solution **2** 1.0 $mg\,cm^{-3}$ of enzyme
- solution **3** 2.0 $mg\,cm^{-3}$ of enzyme

After completing the biuret tests, the absorbance of light by each solution was measured using a colorimeter. The student plotted a graph of the results. The graph is shown in Fig. 3.1.

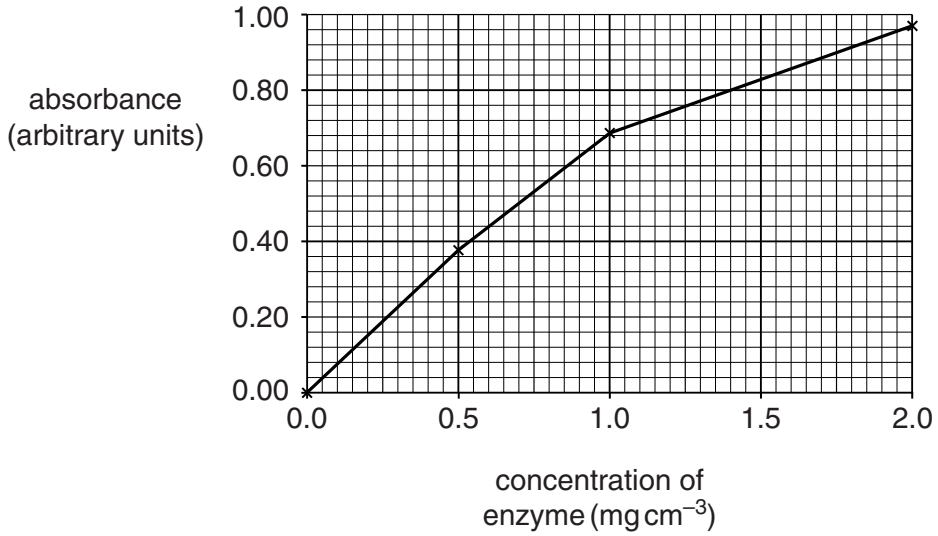


Fig. 3.1

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(i) The student then carried out the same procedure on the enzyme solution of unknown concentration.

The absorbance reading on the colorimeter was 0.8 arbitrary units.

Using the line drawn by the student in Fig. 3.1, determine the concentration of the enzyme solution.

Concentration = ... $mg\,cm^{-3}$

Calculate the **mass** of enzyme, **in grams**, in 250 cm^3 of the enzyme solution.
Show your working. Give your answer to **two** decimal places.

Answer = ... g **[2]**

(ii) The student performed the calculation correctly. However, the teacher said that the value for the mass of enzyme given by the student was inaccurate.

Explain how the student's **method** could be improved to increase the accuracy of this value.

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..... **[2]**

(iii) Outline the practical procedures the student would have taken to generate the point on the graph at the origin (0.0, 0.00).

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..... **[2]**

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(c) Some enzymes work better in the presence of other molecules or ions.

Explain how these molecules or ions increase the activity of enzymes.

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..... **[5]**

[Total: 14]

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4 *Nymphaea thermarum* is the world's smallest and most endangered water lily. It was first discovered by scientists in central Africa, in 1987. It has not been seen in the wild since 2008 and is only known to exist in a few botanic gardens.

(a) *N. thermarum* is the only lily that grows in damp mud rather than water.

The site where it was originally discovered has not been directly affected by the activities of humans in the local area.

Suggest why *N. thermarum* is no longer found in the area where it was first discovered.

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..... **[2]**

(b) Botanic gardens collect plant species from around the world to maintain biodiversity.

(i) State two levels at which biodiversity may be considered.

1 .....

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2 .....

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[2]

(ii) State **one** benefit to human health of maintaining plant biodiversity.

.....

..... **[1]**

(iii) Explain the benefits to agriculture of maintaining plant biodiversity.

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..... **[3]**

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(c) When *N. thermarum* was first collected from the wild, it proved very difficult to grow successfully in a botanic garden.

Some scientists thought that successful growing of *N. thermarum* would depend on the availability of water in the soil.

Outline, briefly, a valid investigation that could determine the effect of varying the moisture content of the soil on the growth of *N. thermarum*.

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..... **[4]**

(d) In 2014, a *N. thermarum* plant was stolen from the Royal Botanical Gardens at Kew.

It is thought that the thief intended to sell the plant to a private collector.

(i) An international agreement exists to restrict the sale of rare species such as *N. thermarum*.

Name this agreement.

..... **[1]**

(ii) Other international agreements exist.

Under the terms of one such agreement, some of the money made **legally** from endangered species goes to the country where the species was first discovered in the wild.

Name the agreement that encourages fair sharing of benefits from the legal use of endangered species.

..... **[1]**

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(e) Individual *N. thermarum* plants measure 10–20 cm across.

Explain why the size of *N. thermarum* is an example of **continuous** variation.

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..... **[3]**

[Total: 17]

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5 Tobacco smoke contains a mixture of chemicals known as tar.

The tar in tobacco smoke has many negative consequences for health.

Outline the effects of tar on the lungs and airways.

In your answer you should discuss a range of effects and their consequences.

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..... **[9]**

[Total: 9]

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6 Six major groups of organisms are listed below:

animals	**bacteria**	**plants**
archaea	**fungi**	**protoctists**

(a) A teacher constructed a **dichotomous key** to help her students distinguish between each of these groups.

The key consisted of a series of questions with '**yes**' or '**no**' answers.

(i) The first question is shown in the box below. Complete the key by choosing the correct answer from the groups of organisms listed.

Question 1: Does the organism have walls made of chitin?

Yes = ...

No go to question 2

[1]

(ii) Write a question in the box below to distinguish plants and protoctists from the remaining groups of organisms.

Question 2: .....

.....

Yes = plants or protoctists

No go to question 3

[1]

(iii) Write a question in the box below to distinguish the archaea and bacteria from animals.

Question 3: .....

.....

Yes = animals

No archaea or bacteria

[1]

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(b) (i) Fig. 6.1 is a diagram representing the taxonomic hierarchy of organisms within the animal kingdom.

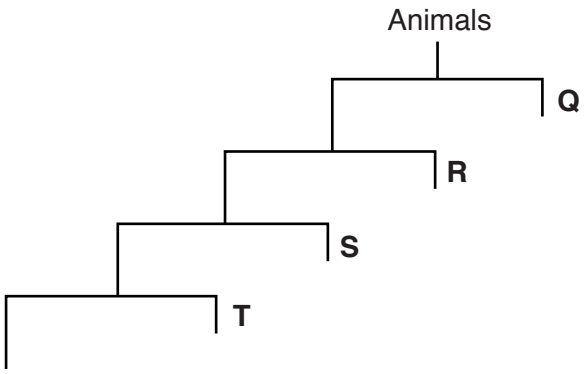


Fig. 6.1

State the level of taxonomic group represented by the letters **Q**, **R**, **S** and **T**.

Q .....

R .....

S .....

T ..... **[2]**

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(ii) Fig. 6.2 shows a diagram representing the phylogenies of some groups of organisms.

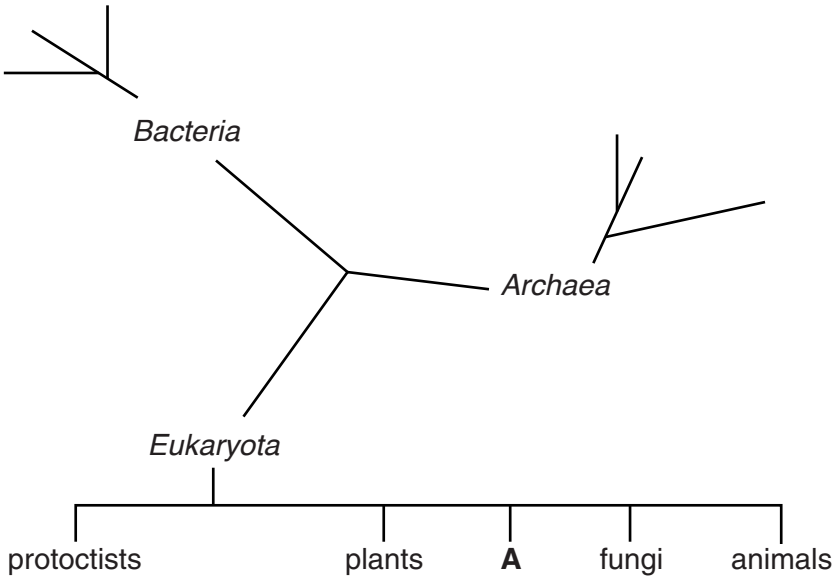


Fig. 6.2

The letter '**A**' on Fig. 6.2 represents a group of organisms called slime moulds.

With reference to Fig. 6.2, discuss the **classification** of slime moulds and include the range of evidence on which this classification might be based.

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..... **[3]**

(iii) State **three** reasons why the three-domain classification system is now used in preference to the five-kingdom system.

1 .....

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2 .....

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3 .....

..... **[3]**

[Total: 11]

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7 Lipoproteins contain protein, cholesterol, triglycerides and phospholipids. They are involved in the transport of cholesterol in the blood.

(a) The protein molecules in a lipoprotein are made up of amino acids. One of these amino acids is alanine.

The R group in alanine is CH_3.

Describe the structure of the amino acid alanine.

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..... **[4]**

(b) **(i)** Explain why a diet high in saturated fat leads to an increase in blood cholesterol.

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..... **[2]**

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(ii) Outline the mechanism by which increased blood cholesterol leads to coronary heart disease (CHD).

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..... **[4]**

(c) Large amounts of fat in the diet can also lead to obesity.

Orlistat is a drug that directly reduces the breakdown of fat in the small intestine. This reduction in breakdown leads to less fat being absorbed into the body.

Suggest the mechanism by which orlistat reduces the breakdown of fat.

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..... **[1]**

[Total: 11]

Question 8 begins on page 20

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8 A teacher was reviewing some common mistakes in a variety of students' answers to biological questions.

Some of the answers given by the students are written below.

(a) "When investigating the effect of temperature on enzyme activity it is important to keep the amount of substrate the same."

Suggest a more suitable word than 'amount'.

..... **[1]**

(b) "Productivity of domestic animals can be improved by selective breeding. However, inbreeding can be a problem as it causes mutations which can lead to genetic diseases in the animals."

State and explain the incorrect biology in this answer.

.....

.....

.....

..... **[2]**

(c) "The Simpson's Index of Diversity for the area of woodland is very high. This means that the habitat is stable and so the electricity company's application to build a power station is likely to be approved after the Environmental Impact Assessment has been carried out."

Explain the incorrect biology in this answer.

.....

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..... **[2]**

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(d) In response to the question "Explain why some types of food are stored in a freezer", a student wrote:

"Food does not decay when frozen because the very low temperature denatures the bacterial enzymes so the enzymes cannot bind to the substrate molecules in the food."

Suggest a better answer to the question.

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..... **[3]**

[Total: 8]

END OF QUESTION PAPER

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ADDITIONAL ANSWER SPACE

If additional answer space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

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GCE

Biology

Unit **F212:** Molecules, Biodiversity, Food and Health

Advanced Subsidiary GCE

Mark Scheme for June 2016

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These are the annotations, (including abbreviations), including those used in scoris, which are used when marking

Annotation	Meaning of annotation
	Correct answer
	Incorrect response
	Benefit of Doubt
	Not Benefit of Doubt
	Error Carried Forward
	Given mark
	Underline (for ambiguous/contradictory wording)
	Omission mark
	Ignore
	Marking point criteria partially met
	Point contributing to QWC* awarded

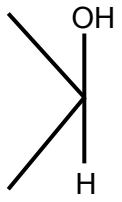
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Here are the subject specific instructions for this question paper

- **CON** is used when a correct response that would otherwise have been awarded a mark is associated with a piece of clearly incorrect science within the same statement. If this occurs, do not award the mark at this point. However, if, later on in the candidate's answer, the correct response is seen, and is not contradicted in the same statement, the mark can be awarded. This is particularly useful in questions testing biochemistry. Sometimes, incorrect science does not warrant negation of a particular marking point and, where this is likely to occur, there is often advice in the Additional Guidance column.
- For questions in which the command word is 'suggest' ignore incorrect responses and credit a correct response wherever it occurs
- Accept phonetic spellings unless otherwise indicated
- All marks are stand-alone unless otherwise stated in Additional Guidance
- For 'idea of' marking points a wide range of wording is acceptable. The mark is to be awarded for the idea.

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Here is the mark scheme for this question paper.

Question			Expected Answers	Mark	Additional Guidance
1	(a)	(i)	X: C / carbon **;** Y: O / oxygen **;** Z: OH / hydroxyl (group) **;**	3	**Mark the first answer.** If the answer is correct and an additional element or group is given = **0 marks.** For example X = C or CH_2 = 0 marks **Y DO NOT CREDIT** O_2 **Z IGNORE** hydroxy / hydroxide **Z IGNORE** OH^-
1	(a)	(ii)	OH and H groups reversed / AW (on single C atom) **;** on , C_1 / right hand C atom / AW **;**	2	*Max 1 if any other change is described / shown*. **CREDIT** a correct diagram **ACCEPT** right hand part of molecule only **IGNORE** parts of molecule labelled X, Y and Z **IGNORE** C number if it contradicts an otherwise correct answer  = 2 marks
1	(a)	(iii)	(α / alpha / a / A) 1-4 glycosidic **;** maltose **;**	2	**ACCEPT** glycosidic 1,4 **IGNORE** covalent

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Question			Expected Answers		Mark	Additional Guidance
1	(b)		**G1**	(contains α-) glucose which is , a respiratory substrate / used in respiration **;**		
			G2	(glycogen) can be , broken down / hydrolysed / digested , by enzymes **;**		**G2 ACCEPT** (glycogen) phosphorylase / transferase / (α1-6) glucosidase / amylase
			S1	polymer / polysaccharide / macromolecule / large molecule / long chains **;**		**S1 IGNORE** many glucose monomers
			S2	insoluble **;**		
			S3	does not affect , water potential **/ Ψ ;**		**S3 IGNORE** refs to osmosis
			C	(compact so) energy dense / large amount of energy in small volume **;**		**C ACCEPT** dense so can store a lot of energy **C ACCEPT** space / mass , as AW for volume
			B1	(also) 1-6 glycosidic bonds (at branches) **;**		
			B2	branched **;**		
			B3	multiple sites / greater surface area / AW , for , breakdown / (named) enzyme activity **;**		
			B4	quickly , broken down / glucose can be removed quickly **;**		**B4 IGNORE** easily **B4 IGNORE** energy release for this marking point
			A1	animals / feature of animal's lifestyle , require , rapid / AW , energy / ATP , release **;**		**A1 ACCEPT** 'they' as AW for 'animal' **A1** must be a direct statement related to an animal's lifestyle, e.g. exercise / muscle contraction / (animal) movement
			A2	animals have high(er) metabolic rate **;**	**6**	
			QWC – *linking structure to function* 1 A mark and 1 B mark **;**		**1**	**AWARD** if, e.g. **A1** and **B2** are given

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Question			Expected Answers	Mark	Additional Guidance
1	(c)		beta- / β- / B / b , pleat(ed sheet) / fold ;		
			hydrogen / H ;		**DO NOT CREDIT** H^+ / H_2
			secondary ;		**ACCEPT** 2° **IGNORE** tertiary / fibrous
			subunits / chains ;		**ACCEPT** globins **IGNORE** strands / units / peptides
			quaternary ;	5	**ACCEPT** 4° **IGNORE** globular
			Total	**[19]**	

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Question			Expected Answers	Mark	Additional Guidance
2	(a)		tick in second box active and artificial ✓ ;	1	**DO NOT CREDIT** if there is a tick in any other box
2	(b)	(i)	viral RNA , acts as , host cell / m , RNA ; RNA , carries , code / sequence (for viral protein) ; (to) ribosomes ;	2 max	**ACCEPT** RNA / DNA , produced from viral RNA **DO NOT CREDIT** tRNA **ACCEPT** RNA is , translated into / used as a template to produce , (viral) protein (or description) **ACCEPT** RNA codes for (viral) protein **DO NOT CREDIT** tRNA **ACCEPT** as a standalone mark

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<table>
<tr><th colspan="3">Question</th><th>Expected Answers</th><th>Mark</th><th>Additional Guidance</th></tr>
<tr><td>2</td><td>(b)</td><td>(ii)</td><td>altered base sequence (of viral RNA) means , altered , primary structure / (sequence of) amino acids ;

R-groups / disulphide bonds / hydrogen bonds / ionic bonds , interact differently ;

tertiary structure is determined by , bonds / R-groups / secondary structure / primary structure / sequence of amino acids ;

3-D shape is tertiary structure ;</td><td>3 max</td><td>ACCEPT if a nucleotide (in RNA) is different the amino acid (in the protein) is different

ACCEPT changed as AW for interact differently

ACCEPT implication that 3D is tertiary structure</td></tr>
<tr><td>2</td><td>(b)</td><td>(iii)</td><td>money would be saved / education improved / fewer sick days / reduced spread (of virus) / good example of health practice / few teachers will have immunity (to current strain) ;</td><td>1</td><td>IGNORE so they don’t get the flu without further qualification
IGNORE because they are at risk of infection</td></tr>
<tr><td>2</td><td>(c)</td><td></td><td><table><tr><th></th><th>primary response</th><th>secondary response</th></tr><tr><td>concentration of antibodies produced</td><td>low(er)</td><td>high(er)</td></tr><tr><td>duration of response</td><td>short(er)</td><td>long(er)</td></tr></table>; ;</td><td>2</td><td>ACCEPT unambiguous AW
IGNORE numbers

ACCEPT stated time periods where secondary response is longer than primary</td></tr>
</table>

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Question			Expected Answers	Mark	Additional Guidance
2	(d)		helper cells , release , cytokines / interleukins **or** helper cells , activate / stimulate / AW , B cells **;** **or** helper cells , produce (T) memory cells ; killer / cytotoxic , cells , secrete / release , toxic substances / hydrogen peroxide / H_2O_2 / perforin **or** killer / cytotoxic , cells , kill / AW , infected cells **;** **or** killer cells , produce (T) memory cells ; memory cells , allow a , secondary / faster , (immune) response **;** AVP **;**	**2 max**	**CREDIT** cause B cells to , differentiate / proliferate **IGNORE** B memory cells **ACCEPT** involved in clonal selection **AWARD** memory cells once only anywhere in the answer **ACCEPT** lysins **IGNORE** enzymes **IGNORE** kill / attack / enter , pathogens **ACCEPT** killer cells , target / attack , infected cells **AWARD** memory cells once only anywhere in the answer **AWARD** memory cells once only anywhere in the answer **AWARD** 1 mark for suppressor cells / regulator cells , stop immune response
			Total	**[11]**	

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Question			Expected Answers	Mark	Additional Guidance
3	(a)	(i)	add / AW, biuret solution / biuret reagent / biuret mixture / NaOH and $CuSO_4$; observe colour ;	2	**IGNORE** 'biuret' unqualified **DO NOT CREDIT** heat / warm / neutralise / put in water bath **ACCEPT** see if it goes , lilac / purple / mauve / violet **DO NOT CREDIT** if incorrect colour change described **DO NOT CREDIT** precipitate
3	(a)	(ii)	(enzymes are) globular , proteins / polypeptide ; hydrophilic / water soluble , (R-)groups on outside (of enzyme) ;	1 max	
3	(b)	(i)	concentration 1.4 ± 0.025 ; 0. 35 ;	2	 **ALLOW ECF** if stated concentration is not 1.4 (i.e. concentration x 250/1000)
3	(b)	(ii)	test more (known) , concentrations / solutions ; between 1.0 and 2.0 / near 1.4 ;	2	**IGNORE** repeat **IGNORE** bigger range of concentrations
3	(b)	(iii)	carry out Biuret test / test again ; (using) no enzyme / no protein / (distilled) water ; set colorimeter to zero ;	2 max	 **DO NOT CREDIT** 'boiled enzyme' Measure absorbance of biuret solution alone = 2 marks

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Question			Expected Answers		Mark	Additional Guidance
3	(c)		1	cofactors / coenzymes / prosthetic groups ;		
			2	bind to , enzyme / active site / allosteric site ;		**2 ACCEPT** prosthetic groups form part of the enzyme
			3	(cofactors / coenzymes , bind to enzyme) temporarily ;		
			4	change , shape / tertiary structure , of active site ;		
			5	affect charges on active site ;		**5 ACCEPT** affects , ionic / hydrogen , bonds in active site
			6	bind to / interact with , substrate ;		**6 IGNORE** in context of prosthetic group
			7	increase (likelihood of) , substrate binding to active site / ESC formation ;		**7 ACCEPT** help the substrate bind to the active site **7 ACCEPT** make ESC formation easier
			8	carry (named) chemical , between / to , (named) enzymes ;	5 max	**8 ACCEPT** substrate as chemical **8 IGNORE** substance
				Total	**[14]**	

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Question			Expected Answers	Mark	Additional Guidance
4	(a)		global warming ; *example of consequence of climate change* mud has dried up / mud now too wet / flooding / disease / (new) herbivore / pest;	2	**ACCEPT** climate change **IGNORE** environmental change **ACCEPT** (new) predator / heavy rainfall / drought **IGNORE** refs to temperature for this marking point **IGNORE** competition
4	(b)	(i)	(at the) level / number / range , of species ; (at the level of) genetics / genes / gene pool / DNA ; (at the level of) habitat / ecosystem ;	2 max	**ACCEPT** amount of species / species richness **IGNORE** species evenness **ACCEPT** e.g. range of habitats **IGNORE** area / in a habitat
4	(b)	(ii)	plants are a source of (new) , medicines / drugs / treatments ;	1	**IGNORE** nutritional / health , benefits **IGNORE** antibiotics
4	(b)	(iii)	*Any three from:* **1** genetic variation / source of (named) useful genes ; **2** (used for) genetic engineering ; **3** (used for) selective breeding / breeding with , cultivated / crop / AW , varieties ; **4** variety might be useful in a changing climate ; **5** (habitat for) pollinators **6** (habitat for) agents of biological control ; **7** source of a new medicine for livestock ;	3 max	**1 ACCEPT** maintaining gene pool / genetic diversity **2 ACCEPT** description of genetic engineering **3 ACCEPT** cross as AW for breed **4 ACCEPT** species as AW for variety **4 ACCEPT** examples of features useful in a different climate, e.g. drought resistance **7 IGNORE** antibiotics

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Question			Expected Answers		Mark	Additional Guidance
4	(c)		1	grow / AW , *(N. thermarum*) in a range of (soil) water content **;**	4 max	**1 IGNORE** in presence and absence of water **1 ACCEPT** in context of , seed / cutting / plug etc
			2	leave for / over , same / stated , time **;**		**2 IGNORE** rate
			3	measure height / count number of (viable) individuals**;**		**3 ACCEPT** measure , (dry) mass / width / spread / number of leaves **3 IGNORE** measure growth
			4	calculate mean (from the results) **;**		**4 ACCEPT** perform statistical test (on the results) **4 IGNORE** average but **ACCEPT** mean average **4 DO NOT CREDIT** if there are no measurements to process
			5	keep two other named variables constant **;**		**5 ACCEPT** (soil) pH / mineral content / type / mass **5 ACCEPT** temperature / CO_2 concentration / light intensity / light duration / light wavelength / number of seeds etc. (if they are being counted) / age / size (if they are being measured) **5 IGNORE** humidity / health / nutrients / species / light availability / soil fertility
4	(d)	(i)	Convention on International Trade in Endangered Species **/** CITES **;**		1	**ACCEPT** CITES acronym even if incorrect words are given **ACCEPT** cites / Cites **IGNORE** extra information that is not contradictory
4	(d)	(ii)	Rio Convention / (Rio) Convention on Bio(logical) Diversity **;**		1	**IGNORE** extra information that is not contradictory

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Question			Expected Answers	Mark	Additional Guidance
4	(e)		range of , values / intermediates ; quantitative ; influenced by environment ; influenced by more than two genes / polygenic ;	3 max	**ACCEPT** no distinct , categories / groups **ACCEPT** (sketch of) normal distribution / bell-shaped curve **IGNORE** 'can be measured' **ACCEPT** example, e.g. those with more access to nitrate could grow larger
			Total	[17]	

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Question			Expected Answers		Mark	Additional Guidance
5			**C1**	damage to / paralyses , cilia / ciliated epithelium **;**		**C1 IGNORE** cilia die / stick together **C1 ACCEPT** destroys cilia
			C2	over-production of mucus by goblet cells **;**		**C2** Must contain the idea of more mucus than normal
			C3	persistent / AW / smoker's , cough to , remove mucus / remove (trapped) pathogens / improve air-flow **;**		**C3** Benefits of coughing must be clearly stated
			C4	an example of damage to airways ;		**C4** forms scar tissue / increases wall thickness / reduces lumen diameter / inflammation / smooth muscle formation **C4 IGNORE** reference to alveoli for this marking point
			B1 **B2**	mucus , accumulates / not wafted by cilia **;** chronic bronchitis **;**		**B1 & C3** Repeated coughing to remove accumulated mucus = 2 marks
			E1	phagocytes , release elastase / break down elastin **;**		**E1 IGNORE** white blood cells **E1 ACCEPT** macrophages / monocytes / neutrophils
			E2 **E3** **E4**	loss of alveolar , recoil **/** elasticity **;** emphysema / COPD **;** damage to alveoli reduces surface area (to volume ratio) for , gas exchange / O_2 uptake **;**		**E4 IGNORE** increased diffusion distance
			L1	causes mutations (in cells lining airways) **;**		**L1 ACCEPT** contains mutagens **L1 IGNORE** carcinogens
			L2	uncontrolled cell , division / multiplication **;**		**L2 IGNORE** growth **L2 IGNORE** ref to speed of cell division
			L3	(lung) cancer / formation of tumour(s) **;**	**8**	**L3 ACCEPT** formation of , mass / lump , of cells
			QWC – range of effects Marks with 3 different letters have been awarded.		**1**	**AWARD** e.g, if C1, B1 and L3 are awarded
				Total	**[9]**	

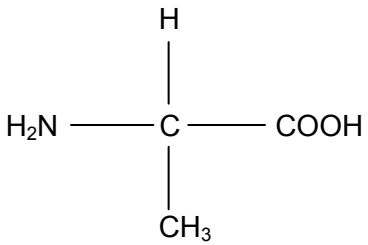
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Question			Expected Answers	Mark	Additional Guidance
6	(a)	(i)	fungi ;	1	
6	(a)	(ii)	(Do the cells have) <u>cellulose</u> cell walls / chloroplasts (?) ;	1	**DO NOT CREDIT** chlorophyll / autotrophic **IGNORE** vacuole
6	(a)	(iii)	(Do the cells have) a nucleus / (named) membrane bound organelles / 80S ribosomes(?) ; (Is the organism) multicellular (?) ;	1 max	**ACCEPT** Are the cells eukaryotic / is a cell wall absent / does it form a blastula / can it produce fertilised eggs(?) **IGNORE** all other responses
6	(b)	(i)	Q phylum / phyla R class S order T family ;;	2	If any answer is wrong **AWARD** max 1 if the other 3 taxa are correct If Q is wrong **AWARD** max 1 if all stated taxa are in the correct **consecutive** sequence **Q IGNORE** phylus
6	(b)	(ii)	**1** eukaryotes / in eukaryote domain ; **2** (classified on the basis of) genetics / amino acid sequences ; **3** genetics / observable features / amino acid sequences , distinct from other , (eukaryotic) kingdoms ; **4** genetics / amino acid sequence , less similar to , protoctists **or** genetics / amino acid sequence , more similar to , plants / fungi ;	3 max	**ACCEPT** 'genes / DNA / RNA / base sequences / proportion of bases' as AW for genetics **4 IGNORE** observable features for this marking point **4 IGNORE** animals

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Question			Expected Answers		Mark	Additional Guidance
6	(b)	(iii)	1	*idea that* 3 domains fits phylogeny better **;**		**1 ACCEPT** e.g. classifies species that are more closely related together / it is a better representation of the true relationship / reflects evolutionary history better **1 IGNORE** clearer **1 IGNORE** reference to common ancestors
			2	(there are) key / many / fundamental / important , differences between , bacteria / prokaryotes , **and** , eukaryotes / other (4) kingdoms **;**		**2 ACCEPT** there are fundamental similarities between the 4 eukaryotic kingdoms that are not shared with prokaryotes
			3	eukaryotes all have , nucleus / membrane-bound organelles / 80S ribosomes **;**		
			4	(there are) key / many / fundamental / important , differences between bacteria and archaea **;**		**4 ACCEPT** 'there are good reasons why prokaryotes should be split' **4 ACCEPT** 'bacteria and archaea are more different that we thought'
			5	bacteria and archaea have different , cell membrane / flagella / (named) enzymes / transcription / DNA replication / RNA **;**	**3 max**	
				Total	**[11]**	

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Question			Expected Answers		Mark	Additional Guidance
7	(a)					**CREDIT** displayed formulae for groups throughout
			1	central , C / carbon (atom) **;**		**1 DO NOT CREDIT** if joined to another group by an incorrect bond
			2	NH_2 / amine (group) **;**		**2 ACCEPT** amino group / HNH
			3	COOH / carboxyl (group) opposite amine group **;**		**3 ACCEPT** carboxylic (acid) group **3 DO NOT CREDIT** if single bond drawn between C and O
			4	CH_3 / methyl (group) , opposite , hydrogen / H **;**		 **= 4 marks**
					4	If diagram is correct, **IGNORE** contradictory prose. If diagram is incorrect, **DO NOT AWARD** mark for correct prose
7	(b)	(i)	increases level of / produces (more), low density lipoproteins / LDL **;**			**ACCEPT** converted to LDLs **IGNORE** saturated fats contain LDLs
			LDLs carry cholesterol from <u>liver</u> to , (named) tissues / cells / blood **;**			
			decreases the activity of (LDL) receptors (on cells) / less binding (of LDL) to cells **;**		**2 max**	

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Question			Expected Answers		Mark	Additional Guidance
7	(b)	(ii)	1	(increased) deposition of , fat / lipid / cholesterol / LDL (in artery wall) ;		1 **ACCEPT** 'build up' as AW for deposit
			2	in artery wall / under endothelium ;		2 **ACCEPT** under , epithelium / lining of artery wall
			3	atherosclerosis / formation of atheroma ;		3 **ACCEPT** plaque formation 3 **IGNORE** arterio- / arth-
			4	narrowing / AW , of lumen of coronary artery ;		4 **IGNORE** conary
			5	reduced / restricted , blood flow ;		
			6	less oxygen delivered to , cardiac / heart , muscle ;	4 max	6 **ACCEPT** myocardium gets less O_2
7	(c)		enzyme / lipase , inhibitor ;		1	**ACCEPT** any description of competitive or non-competitive inhibition of enzyme
				Total	[11]	

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Question			Expected Answers		Mark	Additional Guidance
8	(a)		concentration **;**		1	**IGNORE** volume / mass
8	(b)		**1**	breeding does not cause mutation **;**	2 max	**1 DO NOT AWARD** if any incorrect science is associated with this statement, e.g. 'breeding doesn't cause mutations it just makes them more likely to happen.
				*Any **one** from:*		
			2	mutation is , random / spontaneous / chance **;**		
			3	mutation is , change / damage , to , DNA / base / nucleotide sequence **;**		
			4	inbreeding reduces , gene pool / range of alleles / genetic variation / genetic diversity **;**		
			5	inbreeding increases likelihood of individual possessing two (harmful) recessive alleles (of the same gene) **;**		
8	(c)		**1**	high , Simpson's Index / biodiversity , means not likely to be , approved / built **;**	2 max	**1 ACCEPT** 'will not be' as AW for 'not likely to be'
				*Any **one** from:*		
			2	damage to biodiversity would be great(er) **;**		**2 IGNORE** habitat **2 ACCEPT** rare species might be affected
			3	*idea that* planning decisions are often based on factors other than biodiversity **;**		**3 ACCEPT** EIAs also assess (measures to minimise) impact **3 ACCEPT** the area might be an SSSI already

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Question			Expected Answers		Mark	Additional Guidance
8	(d)		1	enzymes not denatured **;**		**DO NOT CREDIT** if the answer states that the bacterium has been denatured
				*Any **two** from*		
			2	decay / food spoilage , is slow(er) **;**		
			3	molecules / enzymes / substrates , have little / AW , kinetic energy / KE / E_k **;**		**3 DO NOT CREDIT** no kinetic energy
			4	fewer collisions , between substrate and <u>active site</u> / forming ESC **;**		**4 DO NOT CREDIT** no collisions
			5	(liquid) water availability reduced / AW **;**	**3 max**	
				Total	**[8]**	

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APPENDIX 1 – this contains a generic mark scheme grid

Mark Scheme Conventions

The following conventions appear in the Mark Scheme

1. Bracketed words. The words in brackets are there to 'set the scene' and indicate the context in which the answer is expected. They do not need to appear. Award the mark as long as the statement in the brackets is not contradicted.

2. Solidus /. A solidus indicates alternative ways that a mark might be gained for a given Mark Point.

3. Use of the comma in a mark point. This indicates that some information from either side of the comma or commas is needed. It is used in conjunction with the solidus.

   In some cases the Guidance column may indicate examples of wording or terms that are acceptable (ACCEPT) or that should be ignored (IGNORE). In the case of IGNORE read on to see if something creditworthy appears later in the response.

4. Underlining.
   - solid underline. The word or part of word underlined is required but minor mis-spellings are acceptable as long as the word is phonetically the same
   - wavy underline. This indicates that whilst the word underlined is not precisely needed, alternative responses need to be closely related in meaning or be a clear description.

5. *idea of.* This is used as a prefix to marking points where there may be a fairly wide range of responses which cover the essence of the required response. This often requires examiner judgement. These often, but not exclusively, appear in questions such as those related to environmental or health issues.

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Oxford Cambridge and RSA

Monday 1 June 2015 – Afternoon

AS GCE BIOLOGY

F212/01 Molecules, Biodiversity, Food and Health

Candidates answer on the Question Paper.

OCR supplied materials:
None

Other materials required:
- Electronic calculator
- Ruler (cm/mm)

Duration: 1 hour 45 minutes

4837019129

F 2 1 2 0 1

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined pages at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **100**.
-  Where you see this icon you will be awarded marks for the quality of written communication in your answer.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.
- This document consists of **24** pages. Any blank pages are indicated.

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Answer **all** the questions.

1 Pepsin is an enzyme that digests protein foods in the mammalian stomach.

(a) Protein molecules are made from chains of amino acids.

(i) Name the covalent bond between two adjacent amino acids in a chain of amino acids.

..... **[1]**

(ii) Name the type of reaction involved in breaking this bond **and** describe what happens in this reaction.

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..... **[2]**

(b) Describe how an enzyme, such as pepsin, breaks down a substrate.

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..... **[5]**

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(c) A student investigated how changing the pH affected the activity of pepsin.

- He used a blender to make a suspension of egg white (protein) in water.
- At the start of the investigation the suspension was cloudy.
- He prepared fixed concentrations of egg white suspension, acid and pepsin to add to each of six test-tubes.
- He removed 0.1 cm^3 of the mixture from each test-tube and used universal indicator to measure the pH of each mixture.
- He incubated each test-tube in a water bath at 35 °C and timed how long it took for the egg white suspension in each tube to clear.
- He prepared a table in which he recorded his results (Table 1.1).

Tube	Volume of egg white suspension	Volume of acid added (cm^3)	Amount of pepsin added (cm^3)	Measured pH	Time for suspension to clear (m)
1	5	2.0	3.0	1	
2	5	1.5	3.0	2	
3	5	1.0	3.0	3	
4	5	0.5	3.0	4	
5	5	0.0	3.0	5	
6	5	2.0	0.0	1	

Table 1.1

(i) Identify **three** errors the student made in the preparation of his **table** before he recorded his results.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

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(ii) Identify a change the student could make to his procedure that would increase the **validity** of the investigation.

.....

..... **[1]**

(iii) State the term that best describes the purpose of **tube 6**.

..... **[1]**

(iv) Another student suggested that he should repeat the investigation at least twice.

How would this have improved the investigation?

.....

.....

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..... **[2]**

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(d) Fig. 1.1 shows the effect of increasing the substrate concentration on the rate of activity of pepsin.

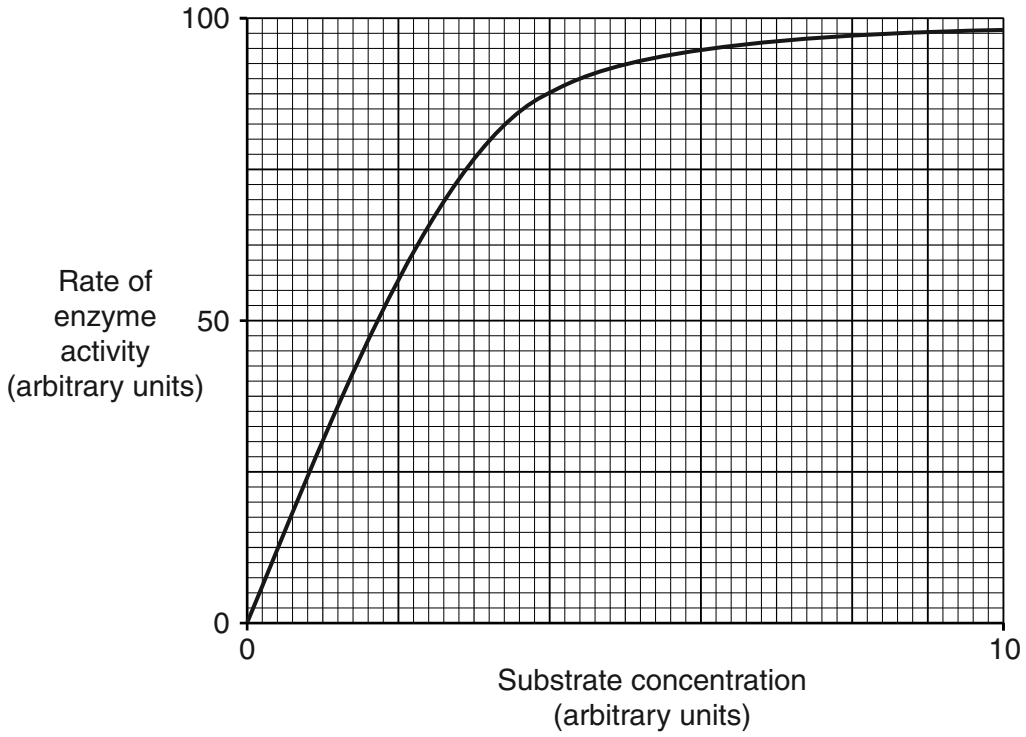


Fig. 1.1

(i) Pepstatin is a competitive inhibitor of pepsin.

On Fig. 1.1, draw a line to represent the effect of adding a fixed concentration of pepstatin on the rate of pepsin activity over the whole range of substrate concentrations.

..... *This should be answered on Fig. 1.1* .....**[2]**

(ii) Pepstatin acts as a competitive inhibitor of pepsin.

What can you conclude about the structure of pepstatin?

.....

.....

.....

..... **[2]**

[Total: 19]

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2 Malaria is a disease that is estimated to kill around 80 people every hour worldwide.

(a) The symptoms of malaria are caused by a single-celled organism belonging to the genus *Plasmodium*.

(i) *Plasmodium* is described as a parasite.

Define the term *parasite*.

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.....

..... **[3]**

(ii) Explain why the human body's primary defences do **not** prevent the entry of *Plasmodium* into the body.

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..... **[2]**

(iii) Suggest why malaria is much more common in tropical areas than in other parts of the world.

.....

.....

..... **[1]**

(iv) Suggest **two** reasons why governments in parts of the world other than tropical areas, are also becoming increasingly concerned about malaria.

.....

.....

.....

.....

..... **[2]**

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(b) People with the disease known as iron-deficient anaemia (IDA) are resistant to malaria. This resistance is not well understood but is thought to involve phagocytosis.

Fig. 2.1 shows the process of phagocytosis of a pathogen by a phagocyte.

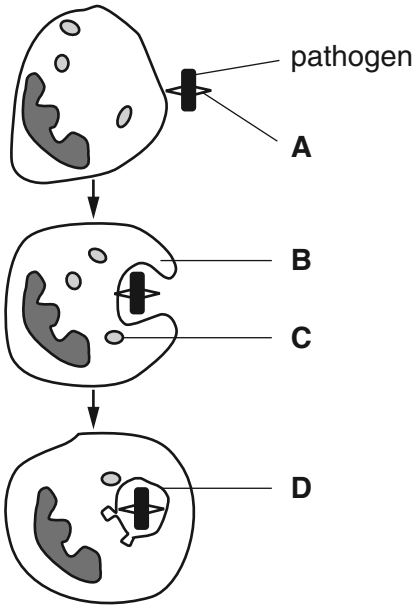


Fig. 2.1

(i) Identify the structures represented by the letters **A**, **B**, **C** and **D**.

A .....

B .....

C .....

D .....

[4]

(ii) In patients with IDA, anaemia is caused by the destruction of erythrocytes (red blood cells) by phagocytosis.

Suggest why erythrocytes that contain *Plasmodium* are more likely to be destroyed by phagocytosis than healthy erythrocytes.

.....

.....

.....

..... **[1]**

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(c) Erythrocytes contain haemoglobin, which is a globular protein.

Blood vessel walls contain collagen, which is a fibrous protein.

Describe the differences between globular and fibrous proteins using haemoglobin and collagen as examples.

In your answer you should refer to collagen and haemoglobin.

[8]

[Total: 21]

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3 Roe deer, *Capreolus capreolus*, is the most common species of native deer in the UK.

Fig. 3.1 shows the distribution of roe deer in the UK in 1972 and 2007. It also shows the location of the sites that were studied in 2007.

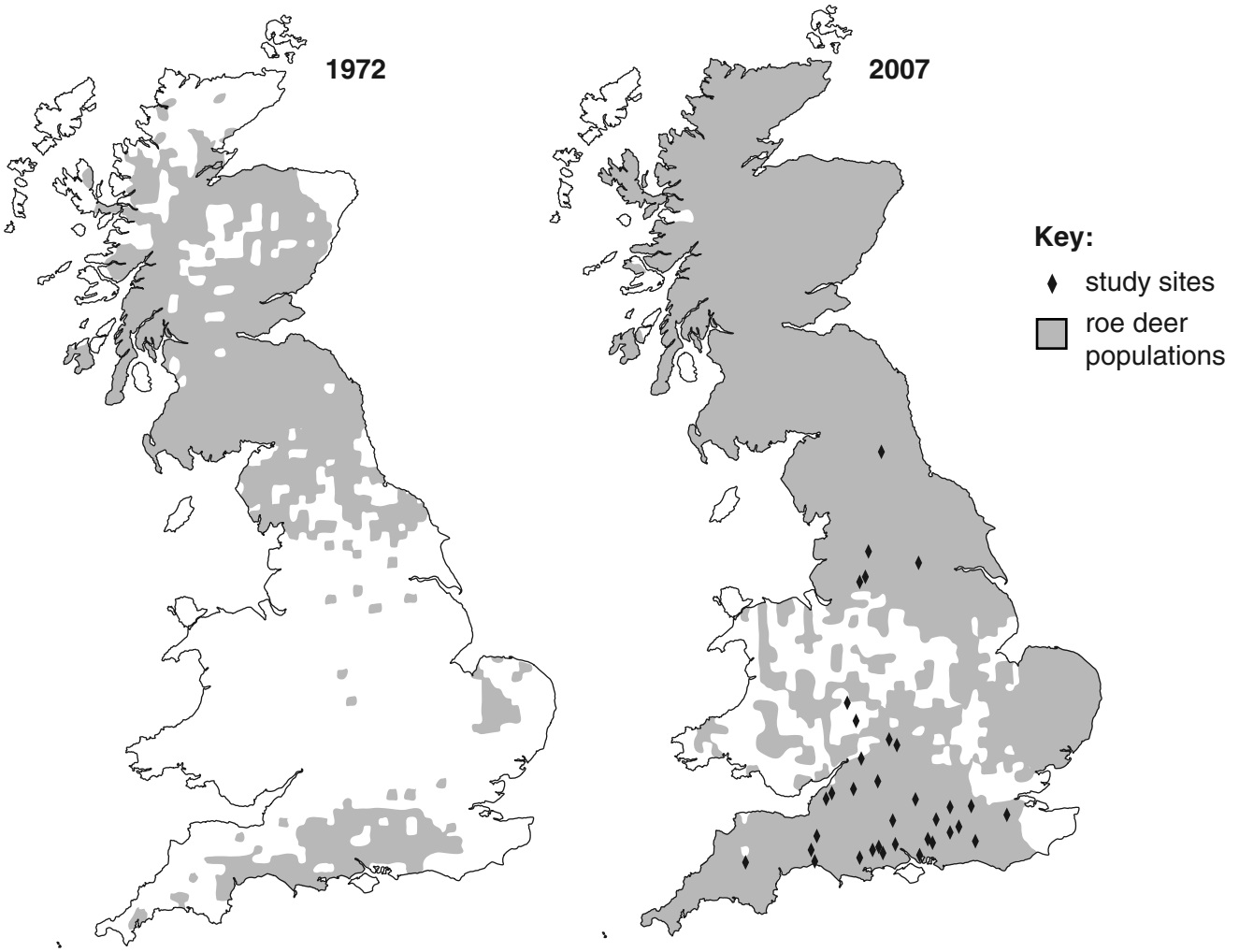


Fig. 3.1

(a) How has the distribution of roe deer changed between 1972 and 2007?

.....

.....

..... **[1]**

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(b) In 2007, scientists studied the effect of roe deer on the biodiversity of the habitat at a number of sites, shown on Fig. 3.1.

At each study site, the scientists sampled plants and animals in unfenced areas where roe deer were present and in fenced areas where roe deer could not go.

(i) Explain the importance of sampling in measuring the biodiversity of a habitat.

.....

.....

.....

..... **[2]**

(ii) Why was it important to take samples in fenced and unfenced areas?

.....

.....

.....

..... **[1]**

(iii) The scientists needed to measure species richness and species evenness to calculate Simpson's Index of Diversity.

Explain the difference between species richness and species evenness and why both measurements are needed to assess biodiversity.

.....

.....

.....

.....

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.....

..... **[3]**

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(iv) In areas where the population of roe deer was high, the Simpson's Index of Diversity was low for shrubs (medium-height plants) and was also low for woodland birds.

Roe deer eat plants. Most woodland birds do not eat plants.

Suggest **one** reason why a large roe deer population might decrease the diversity of woodland birds.

.....

.....

..... **[1]**

(v) Outline the significance of a low value of Simpson's Index of Diversity.

.....

.....

.....

.....

..... **[2]**

(c) In the past, the roe deer's main natural predator in Britain was a large carnivore of the cat family, the Eurasian lynx, *Lynx lynx*. The lynx became extinct in Britain around 1000 years ago.

Populations of Eurasian lynx still survive in parts of mainland Europe.

Plans are being considered to re-introduce the Eurasian lynx from these European populations to the wild parts of Britain to improve biodiversity.

(i) Suggest **one** reason why some people might object to this re-introduction.

.....

.....

..... **[1]**

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(ii) A small population of Iberian lynx, *Lynx pardinus*, exists in parts of Spain. The Iberian lynx is critically endangered and, with around 100 individuals left, it is the world's most endangered species of cat.

The Iberian lynx and Eurasian lynx were once classified within the same species, based on their observable features.

In the last 10 years, the Iberian lynx has been re-classified as a separate species within the genus *Lynx*, on the basis of its phylogeny.

Define the term *phylogeny* and explain how phylogeny is related to classification. Use the two lynx species as examples.

.....

.....

.....

.....

.....

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.....

..... **[4]**

(iii) Suggest why it is only in the last 10 years that the Iberian lynx has been classified as a separate species.

.....

..... **[1]**

(iv) Outline **three** reasons why it is important to conserve the Iberian lynx.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

[Total: 19]

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4 Wheat is an important food crop in many European countries. Developments in farming allowed the yield of wheat produced by farms in the UK to increase rapidly in the second half of the 20th century.

Fig. 4.1 shows the increase in the yield of wheat from 1947 to 1992. The graph also shows the increase that is thought to be as a result of the development of new varieties through selective breeding.

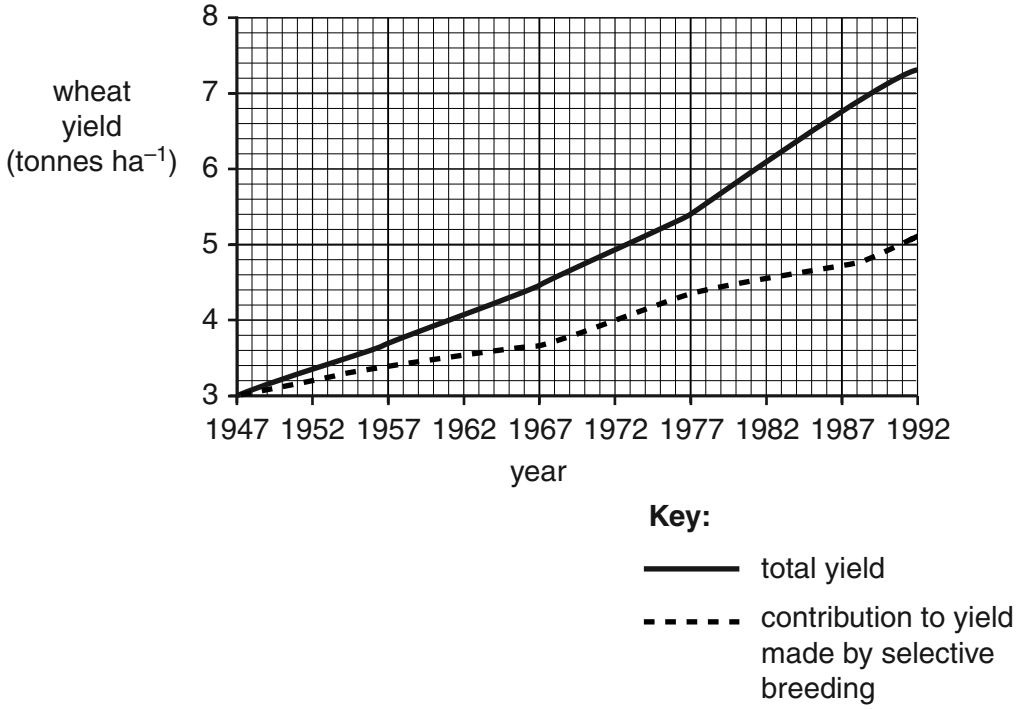


Fig. 4.1

(a) Use the graph to calculate the mean annual increase in total wheat yield between 1947 and 1992. Give your answer to **three decimal places**.

Show your working and include units with your answer.

Answer = ...

Units ..... **[3]**

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(b) Explain how the selective breeding that led to this increased yield could have been done.

.....

.....

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..... **[4]**

(c) State **two** developments, other than selective breeding, that could account for the total increase in wheat yield per hectare.

1 .....

2 .....

[2]

[Total: 9]

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5 Fig. 5.1 shows part of a DNA strand.



Fig. 5.1

(a) (i) Name the base represented by the letter **T**.

..... **[1]**

(ii) On Fig. 5.1, draw a section of the mRNA strand that is complementary to the section of the DNA strand shown.

..... *This should be answered on Fig. 5.1* .....**[2]**

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(b) Table 5.1 contains a list of statements about DNA replication. Some of these statements are incorrect.

Put a cross (**X**) in the box next to each **incorrect** statement.

DNA replication	**Incorrect statement**
The DNA molecule unwinds	
Hydrogen bonds between the base pairs break	
Free RNA nucleotides join to bases on the exposed DNA strands	
Both polypeptide strands act as a template	
Hydrogen bonds form between complementary bases	
Three hydrogen bonds form between bases A and T	
DNA polymerase links the new nucleotides	
Covalent bonds form between the phosphate of one nucleotide and the pentose sugar of the next nucleotide	

[3]

Table 5.1

(c) Complete the following passage by using the most appropriate terms.

Variation can be described as the differences in characteristics between ..... . The type of variation that is caused by differences in DNA is known as ..... variation. Variation can also be caused by the ..... . Variation between members of the same species is known as ..... variation. Evolution depends on variation and ..... of the best adapted individuals. **[5]**

[Total: 11]

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6 Antibodies are important biological molecules.

(a) Describe how the structure of antibodies allows them to perform their function.



In your answer you should clearly link structure to function.

.....

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..... **[7]**

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(b) Antibodies can defend the body against pathogens in a number of ways.

Outline the mode of action of antibodies in defending the body against pathogens by describing the processes of **neutralisation** and **agglutination**.

neutralisation .....

.....

.....

.....

agglutination .....

.....

.....

.....

[4]

[Total: 11]

Question 7 begins on page 20

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7 Lipids are a group of fatty or waxy compounds.

Triglyceride, phospholipid and cholesterol are examples of lipid compounds that are important in living organisms.

(a) Table 7.1 lists a number of statements that could apply to these compounds.

Complete the table by indicating with a tick (✓) which of the compounds applies to each statement.

You may use more than one tick in a row.

Statement	Triglyceride	Phospholipid	Cholesterol
Contains only the elements carbon, hydrogen and oxygen			
Insoluble in water			
Contains glycerol			
Contains ester bonds			
Important in membrane structure			
Contains fatty acids			

[6]

Table 7.1

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(b) Describe how to do the emulsion test for lipids and how a positive result would be identified.

.....

.....

.....

.....

.....

..... **[2]**

(c) Lipids form an essential part of a balanced diet. Some food, such as mycoprotein, is produced by microorganisms.

How might the **lipid** content of mycoprotein differ from food that comes from animals?

.....

.....

.....

..... **[2]**

[Total: 10]

END OF QUESTION PAPER

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ADDITIONAL ANSWER SPACE

If additional answer space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margins.

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GCE

Biology

Unit **F212:** Molecules, Biodiversity, Food and Health

Advanced Subsidiary GCE

Mark Scheme for June 2015

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These are the annotations, (including abbreviations), including those used in scoris, which are used when marking

Annotation	Meaning of annotation
	Correct answer
	Incorrect response
	Benefit of Doubt
	Not Benefit of Doubt
	Error Carried Forward
	Given mark
	Underline (for ambiguous/contradictory wording)
	Omission mark
	Ignore
	Partial correct response
	Partial QWC* mark awarded
	Blank page

Here are the subject specific instructions for this question paper

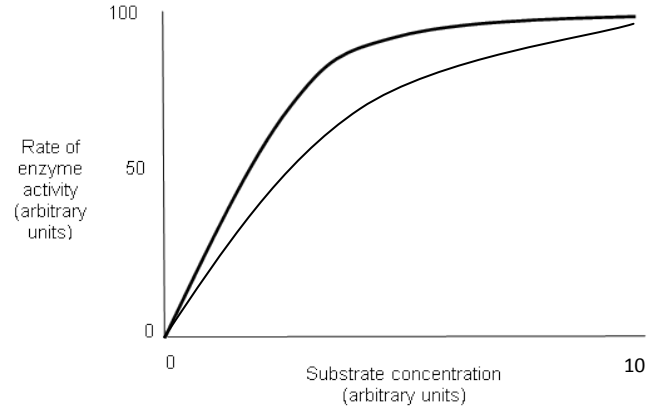
- Use **CON** when a correct response is associated with a piece of clearly incorrect science within the same statement and award no mark.
- For questions in which the command word is 'suggest' ignore incorrect responses and credit a correct response wherever it occurs
- Accept phonetic spellings unless otherwise indicated
- All marks are stand-alone unless otherwise stated in Additional Guidance
- For 'idea of' marking points a wide range of wording is acceptable. The mark is to be awarded for the idea.

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Here is the mark scheme for this question paper.

Question			Expected Answers	Mark	Additional Guidance
1	(a)	(i)	peptide (bond / link) **;**	1	**DO NOT CREDIT** dipeptide
1	(a)	(ii)	hydrolysis **;** water / H_2O , is , added / used / needed **;**	 2	**IGNORE** name of bond **CREDIT** OH and H put back on amino acids **ACCEPT** (broken down) with water
1	(b)		**1** substrate / protein , shape is (nearly) complementary to active site **; ora** **2** substrate / protein , enters / fits into , active site (on enzyme) **;** **3** induced fit / description of induced fit **;** **4** (forms) enzyme-substrate complex / ESC **;** **5** destabilising / straining / AW , of bonds (in substrate) **;** then (forms) enzyme-product complex **;** **6** product(s) / amino acids , leave (active site) **;**	5 max	**1 ACCEPT** complimentary **1** "substrate binds to the active site which is complementary to the substrate shape" = 2 marks, mp1 and mp2 **2 ACCEPT** binds to / holds / bonds to **2 IGNORE** collides **5 IGNORE** breaks **6 IGNORE** EPC
1	(c)	(i)	 no units for , 2nd column / egg white **;** amount (rather than volume / in 4th column) **;** incorrect unit / m , in final / time , column **;**	 3	**IGNORE** prompt, and mark the first three answers. **IGNORE** subsequent answers. **CREDIT** marks clearly annotated on table **ACCEPT** volume of egg white needs cm^3 **ACCEPT** 'they should have written volume' **ACCEPT** should have been s **IGNORE** should have been , sec / secs / seconds

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Question			Expected Answers	Mark	Additional Guidance
1	(c)	(ii)	equal volume in each tube ; add buffer / control pH ;	1	**ACCEPT** "make sure the tubes have the same cm^3"
1	(c)	(iii)	control ;	1	**DO NOT CREDIT** control variable
1	(c)	(iv)	improve reliability ; assess, variability / spread of results ; allows calculation of mean ;	2	**IGNORE** accurate **ACCEPT** identify , anomalous results / outliers **IGNORE** eliminate anomalous results **ACCEPT** reference to statistical test **ACCEPT** standard deviation / t-test / Mann-Whitney **CREDIT** improves accuracy of mean
1	(d)	(i)	line drawn below line on graph ; line from origin that does not peak or plateau ;	2	If the line goes above the original line at any point = 0 marks **ALLOW** lines touching at right hand end **DO NOT CREDIT** line with increasing gradient **ALLOW** plateau if it joins the original line **ALLOW** plateau below original line if it starts 4 small squares (or fewer) from the end  = 2 marks

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Question			Expected Answers	Mark	Additional Guidance
1	(d)	(ii)	similar shape to , substrate / (part of) albumin / protein ; complementary (shape) to (part of) active site ;	2	**IGNORE** same **ACCEPT** same shape as part of substrate **IGNORE** structure **ACCEPT** tertiary structure
			Total	**[19]**	

Question			Expected Answers	Mark	Additional Guidance
2	(a)	(i)	lives , in / on , host ; gains nutrition / feeds , from (host) ; at the expense of / harms (host) ;	3	The word 'host' must appear at least once in order to gain 3 marks **IGNORE** lives off host **IGNORE** binds to host **ACCEPT** e.g. feeds on blood / get food from it / obtains nutrients from the larger organism **DO NOT CREDIT** sometimes harm **ACCEPT** causes disease
2	(a)	(ii)	mosquito / vector / *Anopheles* , feeds on blood ; breaks skin / skin cannot act as barrier / mosquito pierces skin / mosquito bites skin ;	2	**IGNORE** insect **IGNORE** anticoagulant prevents clot formation (as primary defence has already been breached)

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Question			Expected Answers	Mark	Additional Guidance
2	(a)	(iii)	suitable / AW , climate / temperature , for , mosquito / vector / *Anopheles* **;** **ora** more mosquitoes live there / AW ; **ora** *idea of* relatively poor so methods of prevention less effective **;**	1	**ACCEPT** 'warm enough for mosquitoes' **IGNORE** tropical as AW for 'warm' **IGNORE** mosquito is adapted to survive there **ACCEPT** e.g. can't afford , drugs / mosquito nets / habitat management / insecticides **ACCEPT** lack of education
2	(a)	(iv)	**1** climate change / global warming / AW , may result in spread to other parts of the world / AW **;** **2** *idea of* increased movement of (infected) people **;** **3** *idea that* (non-malaria) countries fund anti-malaria measures via international aid **;** **4** resistance of , parasite to drugs / mosquito to insecticides **;**	2 max	**2 ACCEPT** increased tourism / easier to travel **2 ACCEPT** inadvertent transport of mosquitoes **4 IGNORE** 'resistance' without further qualification **4 DO NOT CREDIT** immune
2	(b)	(i)	**A** antigen **;** **B** (extension of) cytoplasm **;** **C** lysosome **;** **D** phagosome / phagocytic vesicle / phago-lysosome **;**	4	**Mark the first answer.** If the answer is correct and another answer is given that is incorrect or contradicts the original answer, then = **0 marks** **B ACCEPT** pseudopod (ia / ium) or close spelling **B IGNORE** neutrophil **C IGNORE** lysome / lysozyme **D ACCEPT** phagocytic vacuole / secondary lysosome

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Question			Expected Answers	Mark	Additional Guidance
2	(b)	(ii)	(different) chemicals that attract phagocytes (released from infected erythrocytes) **;**	1	**ACCEPT** in the context of chemicals released by erythrocyte or *Plasmodium* **ACCEPT** cytokines / histamine / interleukin , released **IGNORE** references to antigens on surface
2	(c)		*Globular* **G1** ball (shaped) / spherical / AW **;** **G2** hydrophilic , (R-)groups / regions , on outside (of 3-D structure) / hydrophobic (R-)groups on inside **;** **G3** form H-bonds with water **;** **G4** soluble **;** **G5** example of globular protein (other than haemoglobin) **;** **H1** haemoglobin , carries / transports , oxygen / carbon dioxide **;** **H2** haemoglobin contains , prosthetic group / haem / Fe^{2+} / iron ion (to allow oxygen to be carried) ; **H3** (polypeptide chains within) haemoglobin have tertiary structure (in a ball shape) ;		**G1 IGNORE** round / globular **G5 ACCEPT** (named) enzyme / hormone / antibody / channel / carrier **G5 IGNORE** metabolic / transport **H1 ACCEPT** references to buffering **H2 IGNORE** Fe^{3+} **H3 ACCEPT** haemoglobin has tertiary structure

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			F1	*Fibrous* linear / long (chain) **;**		**F1 ACCEPT** straight / rope-like **F1 IGNORE** strand
			F2	(chains can) form (H) bonds with adjacent , chains (within a molecule) **;**		**F2 IGNORE** fibre / fibril **F2 ACCEPT** 'strand' as AW for 'chain' for **F2** only **F2 ACCEPT** crosslink as AW for bond for **F2** only **F2 DO NOT CREDIT** molecule as 'AW' for 'chain' **F2 IGNORE** attractions / (named) covalent bonds
			F3	insoluble / few hydrophilic groups **;**		
			F4	strong / provide strength **;**		**F4 IGNORE** flexible / inelastic / withstands pressure
			F5	have structural role ;		
			C1	collagen has high proportion of glycine , so chains can lie close together / AW **;**		
			C2	collagen forms , crosslinks / covalent bonds , between molecules **;**		**C2 ACCEPT** (micro / macro) fibrils / fibres , as AW for molecules
			C3	crosslinks / ends of molecules, are staggered to avoid , weak points / AW **;**		**C3 ACCEPT** (micro / macro) fibrils / fibres , as AW for molecules
			C4	collagen forms part of , tendon / cartilage / ligament / bone / connective tissue / bronchi / bronchioles / trachea / skin **;**	**7 max**	**C4 IGNORE** blood vessel / artery / vein , wall **C4 IGNORE** lips
			QWC – use of haemoglobin and collagen as examples		**1**	**AWARD** if any H mark **and** any C mark are awarded
				Total	**[21]**	

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Question			Expected Answers	Mark	Additional Guidance
3	(a)		spread over wider area / more widespread / bigger range / AW ;	1	**ACCEPT** geographical description, e.g. 'they now live in the South / Wales also' but answer must imply that they still live in previously occupied areas **IGNORE** *idea of* higher numbers **IGNORE** bigger / more without further qualification
3	(b)	(i)	impossible / difficult , to count every individual ; sample provides an estimate ; sample representative (of whole area) ;	2 max	**ACCEPT** *idea that* counting every individual is too time consuming
3	(b)	(ii)	to compare (the two areas) ; (presence or absence of) roe deer is independent variable ; *idea of* controlling variables other than roe deer ;	1 max	**ACCEPT** one area acts as a control **ACCEPT** to see the effect of the roe deer
3	(b)	(iii)	**1** (species) richness is number of species (in a habitat) ; **2** (species) evenness is , abundance / number of individuals of , each / every / all , species (in a habitat) ; **3** *idea that* both (richness and evenness) are needed to reveal dominance ; **4** *idea that* high biodiversity associated with high species richness **and** high species evenness ;	3 max	**IGNORE** amount **ACCEPT** 'how many' as AW for 'number' **ACCEPT** evenness is relative , numbers / abundance , of (each) species **IGNORE** number of individuals of , a / the / one , species

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Question			Expected Answers	Mark	Additional Guidance
3	(b)	(iv)	plants are , the basis / AW , of (all) food chains **;** shrubs / plants , are food for , insects / animals , that birds eat **;** *idea that* shrubs might provide , nesting sites / cover / protection / habitat **;**	**1 max**	**IGNORE** birds eat , shrubs / seeds / fruit **IGNORE** 'fewer insects' without reason for fewer insects **AWARD** in the context of birds, or animals that birds eat **IGNORE** home
	(b)	(v)	(habitat) dominated by, one / few / AW, species **;** ecosystem / habitat , is , unstable / less likely to cope with change **;**	**2**	**ACCEPT** high number of one species **IGNORE** area / environment **ACCEPT** in the context of an example of environmental change **ACCEPT** a change in one species with have a large effect on the , ecosystem / habitat / food chain
3	(c)	(i)	*idea of* danger to , humans / local wildlife / domestic animals / deer **;** environment may no longer be suitable for lynx / AW **;**	**1**	**ACCEPT** *idea of* danger to existing food chains **IGNORE** could become a pest **IGNORE** dangerous without further qualification **IGNORE** competition

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Question			Expected Answers	Mark	Additional Guidance
3	(c)	(ii)	**1** (phylogeny is) the evolutionary , relationship between / history of , organisms / species **;** **2** phylogeny is the basis of classification ; **3** example of molecular evidence used to classify **;** **4** species / organisms , within the same group have shared , phylogeny / evolutionary history / common ancestor **; ora** **5** *idea that* phylogeny of *L. lynx* and *L. pardinus* are sufficiently , different to have been placed in separate species / similar to have been placed in same genus **;**	**4 max**	**1 ACCEPT** reasonable description of evolutionary , history / relationship, e.g. changes in ancestral organisms **2** Must be a clear statement **3 ACCEPT** base sequence / amino acid sequence / DNA / cytochrome C / haemoglobin / ATPase (used to classify)
3	(c)	(iii)	modern / new / better , technology (to distinguish between closely related species) **;** more , molecular / biochemical / DNA / genetic , evidence **;**	**1**	**ACCEPT** named example, e.g. DNA sequencing

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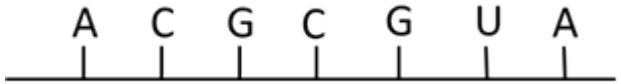
Question			Expected Answers	Mark	Additional Guidance
3	(c)	(iv)	**1** *idea of* impact on food chain(s) **;** **2** *idea of* right to exist / duty of humans to care for other species / ethical reason / preserving species for future generations **;** **3** *idea of* aesthetic reason **;** **4** economic reason / tourism / might provide useful resource **;**	**3max**	**1 ACCEPT** controlling deer population **1 ACCEPT** top carnivore / top predator / keystone species / it might compete with existing species **1 IGNORE** other species might die **2 IGNORE** 'playing God' **2 IGNORE** refs to poaching / hunting **3 ACCEPT** beautiful creatures / nice to look at / AW
			Total	**[19]**	

Question			Expected Answers	Mark	Additional Guidance
4	(a)		0.096 **; ;** tonnes ha^{-1} y^{-1} **;**	**3**	If answer is incorrect **CREDIT** one mark for correctly identifying a difference of 4.3 (tonnes ha^{-1}) **ACCEPT** tonnes per hectare per , year **ACCEPT** tonnes ha^{-1}/yr **ACCEPT** tonnes ha^{-1} per year **IGNORE** annum

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Question			Expected Answers	Mark	Additional Guidance
4	(b)		**1** crossbreed / breed / interbreed , high-yielding , wheat plants / individuals **;**		**1 ACCEPT** breed high-yielding individuals **1 ACCEPT** 'mate / reproduce' as AW for 'breed' **1 IGNORE** inbreed **1 ACCEPT** description of high-yielding plant, e.g. more , ears / grain / seed / wheat **1 ACCEPT** if only one of the plants is high-yielding
			2 assess / test / measure , yield / AW **;**		**2 IGNORE** select the best offspring
			3 crossbreed / AW , selected / best / high-yielding , offspring **;**		
			4 over generations **;**		**4 ACCEPT** several / a few generations **4 IGNORE** time
			5 marker assisted selection / prevent self-pollination / genetic screening / prevent unwanted (cross) pollination **;**	**4 max**	**5 ACCEPT** descriptions **5 IGNORE** the ones with the correct gene **5 ACCEPT** prevent self-fertilization
4	(c)				**IGNORE** prompt lines and mark as prose **IGNORE** refs to climate change
			(use of) fertiliser **;**		**IGNORE** crop rotation **IGNORE** increase in soil minerals **IGNORE** irrigation
			(use of) pesticide / fungicide / insecticide **;**		**ACCEPT** selective herbicide **IGNORE** decrease in pests
			improved technology **;**	**2 max**	**ACCEPT** e.g. better harvesting technology **IGNORE** genetic modification / irrigation
			Total	**[9]**	

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<table>
<tr><th colspan="3">Question</th><th>Expected Answers</th><th>Mark</th><th>Additional Guidance</th></tr>
<tr><td>5</td><td>(a)</td><td>(i)</td><td>thymine ;</td><td>1</td><td></td></tr>
<tr><td>5</td><td>(a)</td><td>(ii)</td><td>correct complementary sequence ;
bases joined by a backbone drawn below the letters ;</td><td>2</td><td>IGNORE bonds between bases
 

= 2 marks</td></tr>
<tr><td>5</td><td>(b)</td><td></td><td>
<table>
<tr><th>Statement</th><th>Incorrect statements</th></tr>
<tr><td>The DNA molecule unwinds</td><td></td></tr>
<tr><td>Hydrogen bonds between the base pairs break</td><td></td></tr>
<tr><td>Free RNA nucleotides join to bases on the exposed DNA strands</td><td>X ;</td></tr>
<tr><td>Both polypeptide strands act as a template</td><td>X ;</td></tr>
<tr><td>Hydrogen bonds form between complementary bases</td><td></td></tr>
<tr><td>3 hydrogen bonds form between bases A and T</td><td>X ;</td></tr>
<tr><td>DNA polymerase links the new nucleotides</td><td></td></tr>
<tr><td>Covalent bonds form between the phosphate of one nucleotide and the pentose sugar of the next nucleotide</td><td></td></tr>
</table>
</td><td>3</td><td>Four ‘X’s – max 2
Five ‘X’s – max 1
Six or more ‘X’s – DO NOT CREDIT any marks
If candidate does not use ‘X’, ACCEPT unambiguous system of indicating correct answers.</td></tr>
<tr><th colspan="3">Question</th><th>Expected Answers</th><th>Mark</th><th>Additional Guidance</th></tr>
</table>

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Question			Expected Answers	Mark	Additional Guidance
5	(c)				**Mark the first answer.** If the answer is correct and another answer is given that is incorrect or contradicts the original answer, then = **0 marks**
			1 individuals / organisms / species / phenotypes ;		**IGNORE** offspring
			2 genetic ;		**ACCEPT** inherited / genetical
			3 environment ;		**IGNORE** named example of environment, e.g. diet
			4 intraspecific ;		**ACCEPT** intraspecies
			5 selection / survival ;		**ACCEPT** breeding / reproduction **ACCEPT** natural selection / survival of the fittest
				5	
			Total	**[11]**	

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Question			Expected Answers		Mark	Additional Guidance
6	(a)				6 max	**CREDIT** marking points from a suitably annotated correctly labelled diagrams but read text first
			1	2 light chains and 2 heavy chains / 4 polypeptide chains **;**		**1 IGNORE** long / short **1 CREDIT** implication from labelled diagram
			2	variable region allows , binding / attachment , to antigen **;**		**2 IGNORE** complementary **2 ALLOW** AW for region
			3	two variable regions allow binding of more than one (of the same) antigen **;**		**3 ALLOW** AW for region
			4	variable region on different antibodies allows specificity to different antigens **;**		**4 ALLOW** AW for region
			5	constant region allows , recognition by / attachment to / binding to , (named) phagocytes **;**		**5 ALLOW** AW for region **5 IGNORE** complementary
			6	hinge (region) allows flexibility **;**		**6 ACCEPT** allows arms to , move / bend
			7	disulfide , bonds / bridges **,** hold , polypeptides / light and heavy chains , together **;**		
			QWC – statements linking structure and function for variable region and one other region		**1**	**AWARD** if one mark from 2 to 4 and one mark from 5 to 7 are given

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Question			Expected Answers	Mark	Additional Guidance
6	(b)		*neutralisation* **N1** cover / block , binding site / antigen / receptor site (on pathogen) **;** **N2** bind to toxins **;** **N3** prevent **,** binding / entry **,** to (host) cell **;** *agglutination* **A1** clump / bind together , (many) pathogens **;** **A2** (clump) too large to , enter (host) cell / cross membranes **;** **A3** increase likelihood of being consumed by (named) phagocyte / more can be consumed by phagocyte at once **;**	**4**	If neutralisation is correctly described but labelled agglutination, **DO NOT CREDIT** the first mark but apply **ECF** thereafter **IGNORE** references to parts of antibody, e.g. variable / constant **N1 IGNORE** binds **N3 IGNORE** prevent pathogen reproduction **N3 GNORE** 'harm / infect , host cell' If neutralisation is correctly described but labelled agglutination, **DO NOT CREDIT** the first mark but apply **ECF** thereafter **A2 IGNORE** move **A3 IGNORE** 'white blood cell' **A3 DO NOT CREDIT** lymphocyte **A3 ACCEPT** eaten by phagocytes more easily
			Total	**[11]**	

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<table>
<tr><th colspan="3">Question</th><th>Expected Answers</th><th>Mark</th><th>Additional Guidance</th></tr>
<tr><td>7</td><td>(a)</td><td>(i)</td><td>
<table>
<tr><th>Statement</th><th>tri-glyceride</th><th>phospho-lipid</th><th>cholesterol</th></tr>
<tr><td>contains only the elements carbon, hydrogen and oxygen</td><td>✓</td><td></td><td>✓</td></tr>
<tr><td>insoluble in water</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>contains glycerol</td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>contains ester bonds</td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>important in membrane structure</td><td></td><td>✓</td><td>✓</td></tr>
<tr><td>contains fatty acids</td><td>✓</td><td>✓</td><td></td></tr>
</table>
;
;
;
;
;
;
</td><td>6</td><td>AWARD one mark per correct row
ACCEPT use of an unambiguous symbol other than a tick (e.g. Y)
DO NOT CREDIT if there is any ambiguity in the symbol used</td></tr>
<tr><td>7</td><td>(b)</td><td></td><td>mix with / add , ethanol / alcohol , and water ;

(goes) cloudy ;</td><td>2</td><td>DO NOT CREDIT reference to any incorrect biochemical test

ACCEPT milky / white (emulsion)
DO NOT CREDIT precipitate</td></tr>
<tr><td>7</td><td>(c)</td><td></td><td>less (overall , lipid / fat) ;

less / no , saturated (fat / lipid / fatty acids) ;

more unsaturated (fat / lipid / fatty acids) ;</td><td>2 max</td><td>Cannot be inferred from marking points 2 and 3
ACCEPT no / less , cholesterol
ACCEPT meat has more

ACCEPT meat has more

ACCEPT meat has less

“Higher ratio of unsaturated to saturated” = 2 marks (mp 2 and 3)</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>[10]</td><td></td></tr>
</table>

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APPENDIX 1 – this contains a generic mark scheme grid

Mark Scheme Conventions
The following conventions appear in the Mark Scheme

- Bracketed words. The words in brackets are there to 'set the scene' and indicate the context in which the answer is expected. They do not need to appear. Award the mark as long as the statement in the brackets is not contradicted.
- Solidus /. A solidus indicates alternative ways that a mark might be gained for a given Mark Point.
- Use of the comma in a mark point. This indicates that some information from either side of the comma or commas is needed. It is used in conjunction with the solidus.
- In some cases the Guidance column may indicate examples of wording or terms that are acceptable (ACCEPT) or that should be ignored (IGNORE). In the case of IGNORE read on (or previously) to see if something creditworthy appears later in the response.
- Underlining
    - solid underline. The word or part of word underlined is required but minor mis-spellings are acceptable as long as the word is phonetically the same
    - wavy underline. This indicates that whilst the word underlined is not precisely needed, alternative responses need to be closely related in meaning or be a clear description.
- *idea of.* This is used as a prefix to marking points where there may be a fairly wide range of responses which cover the essence of the required response. This often requires examiner judgement. These often, but not exclusively, appear in questions related to environmental or health issues.

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Monday 2 June 2014 – Afternoon

AS GCE BIOLOGY

F212/01 Molecules, Biodiversity, Food and Health

Candidates answer on the Question Paper.

OCR supplied materials:
None

Other materials required:
- Electronic calculator
- Ruler (cm/mm)

Duration: 1 hour 45 minutes

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined pages at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **100**.
- Where you see this icon you will be awarded marks for the quality of written communication in your answer.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.
- This document consists of **24** pages. Any blank pages are indicated.

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Answer **all** the questions.

1 In 2006, the scientific journal, Nature, reported the discovery of a fossil from around 380 million years ago. It was given the name *Tiktaalik roseae*.

This fossil has some features in common with fish and some features in common with amphibians.

A photograph of the fossil is shown in Fig. 1.1.



Fig. 1.1

A diagram of the fossil viewed from above is shown in Fig. 1.2.

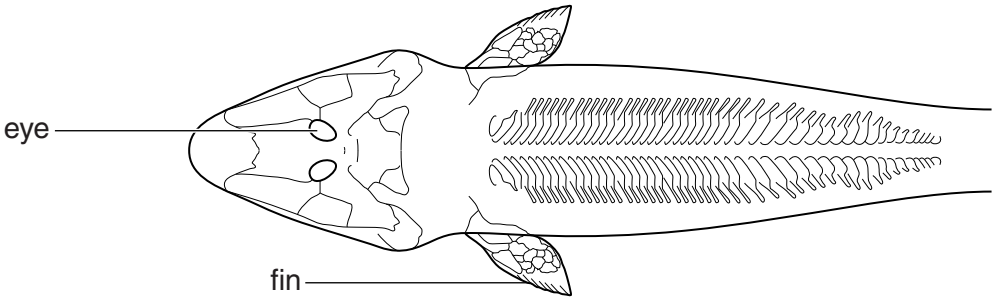


Fig. 1.2

(a) (i) Suggest **one** adaptation, **visible in Fig. 1.1 and Fig. 1.2**, which would be an advantage for life under water.

.....

..... **[1]**

(ii) Suggest **one** adaptation, **visible in Fig. 1.1 and Fig. 1.2**, which would be useful for an animal that lives on the sea bed.

.....

..... **[1]**

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(b) *Tiktaalik roseae* is a member of the kingdom Animalia. The structure of its individual cells has not been preserved by fossilisation.

State **two** features of cells of an organism from the kingdom **Plantae** that would **not** have been present in the cells of *T. roseae.*

1 .....

2 .....

[2]

(c) Fossils provide strong evidence that organisms have evolved over time.

Describe **other** types of evidence that support the theory of evolution.

In your answer you should describe some different types of evidence.

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[6]

[Total: 10]

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2 Many reactions in living organisms are catalysed by enzymes.

Amylase is an extracellular enzyme that catalyses the breakdown of the polysaccharide starch (amylose) in the digestive system of many animals.

(a) Why is the enzyme amylase described as being extracellular?

.....

.....

..... **[1]**

(b) A student investigated the effect of changing the concentration of starch on the rate of starch breakdown by amylase.

The results of the investigation are shown in Fig. 2.1.

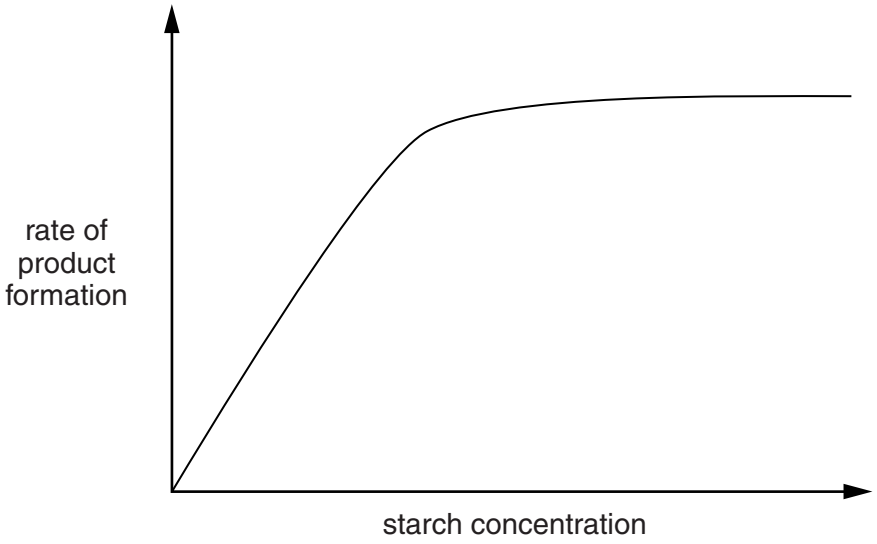


Fig. 2.1

(i) To calculate the rate of starch breakdown, the student measured the concentration of the breakdown **product**.

State the other variable the student needed to know in order to calculate the **rate** of this reaction.

..... **[1]**

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(ii) **Explain** the shape of the graph shown in Fig. 2.1.

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..... **[5]**

(iii) The student kept the pH of the solution constant during the experiment.

Explain why it is important that the pH was kept constant.

.....

.....

.....

.....

.....

.....

..... **[3]**

(iv) Suggest **two** other variables the student should have kept constant during the experiment.

1 .....

.....

2 .....

..... **[2]**

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(c) Cellulose is another polysaccharide that is present in some living organisms.

(i) Complete the following table to show **three** other differences in the **structures** of starch (amylose) and cellulose molecules.

Amylose	Cellulose
coiled	no coiling

[3]

(ii) Which properties of cellulose make it suitable for forming cell walls?

.....

.....

..... **[2]**

[Total: 17]

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Question 3 starts on page 8

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3 The Royal Botanic Gardens at Kew plays an important role in plant conservation. One plant that has been conserved at Kew is the world's smallest water lily, the thermal lily, *Nymphaea thermarum*.

In its natural habitat, the thermal lily grows in hot water springs in central Africa.

(a) State the genus to which the thermal lily belongs.

..... **[1]**

(b) Explain why it is sometimes necessary to conserve a plant species, such as *N. thermarum*, outside its natural habitat (*ex situ*).

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..... **[3]**

(c) The Royal Botanic Gardens also manages the Millennium Seed Bank, which aims to store seeds from one quarter of all plant species.

Give **three** advantages of conserving plant species as seeds and **not** as adult plants.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

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(d) When measuring the biodiversity of a habitat, it is difficult to count every organism. It is therefore necessary to sample a proportion of the habitat. The sampling process must not be biased.

Outline an unbiased sampling method that can be used to measure the biodiversity of plant species in grassland.

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..... **[4]**

(e) Scientists try to estimate the total number of species on Earth.

Suggest **three** reasons why such estimates are not likely to be accurate.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

[Total: 14]

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4 Proteins are important biological molecules.

(a) Protein structure can be represented at four levels: primary, secondary, tertiary and quaternary.

Below is a set of features that may be used when describing the structure of a protein such as haemoglobin.

Features	Letter
hydrogen bonds	**A**
peptide bonds	**B**
α and β subunits	**C**
the sequence of amino acids	**D**
the initial folding of the polypeptide chain	**E**
the overall 3D shape	**F**
ionic bonds	**G**

(i) Select the letters of the features that describe the primary level of protein structure.

..... **[1]**

(ii) Select the letter or letters of the feature(s) found in the secondary level of protein structure that are **not** present in the primary structure.

..... **[1]**

(iii) Select the letter or letters of the feature(s) that are found in the tertiary level of protein structure that are **not** present in the primary and secondary structures.

..... **[1]**

(iv) Select the letter or letters of the feature(s) found only in the quaternary level of protein structure.

..... **[1]**

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(b) Hydrogen bonds also form between water molecules.

(i) Describe the formation of a hydrogen bond between two molecules of water and explain why water can form these bonds.

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..... **[3]**

(ii) Hydrogen bonds allow water to act as a solvent.

Why is the ability of water to act as a solvent important for the survival of organisms?

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..... **[3]**

[Total: 10]

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5 Charles Darwin sailed on HMS Beagle on its voyage around the world between 1831 and 1836.

(a) Darwin made the following observation:

'offspring generally appear similar to their parents'

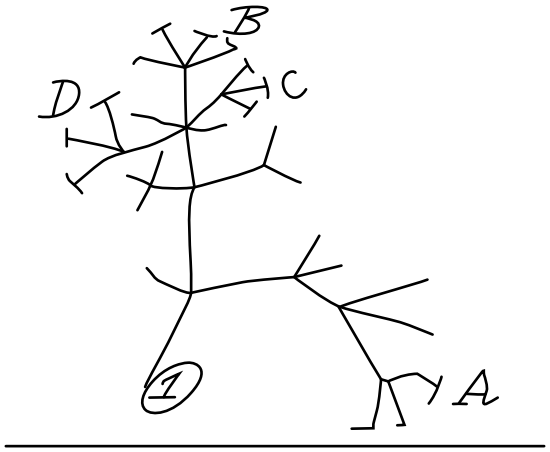
State the conclusion that Darwin drew from this observation.

.....

..... **[1]**

(b) Shortly after the voyage, Darwin sketched a diagram in his notebook.

His sketch is shown in Fig. 5.1.



Charles Darwin (1837)

Fig. 5.1

- A, B, C and D represent different modern day organisms.
- (1) represents an ancestral organism.

Explain what the sketch shows about the relationship between organisms A, B, C, and D.

.....

.....

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.....

.....

..... **[2]**

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(c) In 1859, Darwin published his book, *On the Origin of Species*, in which he explained how organisms evolve by natural selection:

- Darwin's book caused controversy at the time of its publication
- his theory of natural selection is now widely accepted by scientists.

Why is natural selection now more widely accepted by scientists than it was in the 19th Century?

.....

..... **[1]**

(d) Genes are important in the process of natural selection. Genes are made of DNA.

(i) State the role of a gene.

.....

..... **[1]**

(ii) Explain how the structure of DNA allows replication.

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..... **[5]**

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(e) During the voyage of HMS Beagle, Darwin visited the Galapagos Islands off the coast of South America.

He observed that many of the closely related species showed significant variation.

(i) State the name given to the evolution of a new species.

..... **[1]**

(ii) Suggest why a higher number of species have evolved in the Galapagos Islands, compared with an area of the same size on the South American mainland.

.....

.....

.....

..... **[1]**

[Total: 12]

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Question 6 starts on page 16

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6 Smoking has a number of negative effects on a person's health.

(a) State what is meant by the term *health.*

.....

.....

..... **[2]**

(b) An investigation was carried out on the causes of death in a large number of heavy smokers.

- The investigators recorded the number of deaths from a range of diseases within the group of smokers.
- This was compared with the expected number of deaths from the same number of people across the population as a whole.

The results are shown in Table 6.1.

Cause of death	Recorded deaths	Expected deaths	Percentage by which deaths are increased in smokers
Coronary heart disease (CHD)	3361	1973	70.3
Lung cancer	397	37	973.0
Other lung diseases e.g. COPD	231	81	

Table 6.1

(i) Calculate the percentage by which deaths from **other lung diseases** was increased in the smoking group. Show your working and **write your answer in the table**.

[2]

(ii) Outline **two** conclusions that could be drawn from the data in Table 6.1 about the effects of smoking on lung cancer or CHD.

1 .....

.....

2 .....

.....

[2]

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(c) Describe how the components of tobacco smoke can affect the **cardiovascular system** of smokers.

In your answer you should link the chemicals in tobacco smoke to their effects on the cardiovascular system.

.... **[7]**

[Total: 13]

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7 A breed of cattle, known as Chillingham cattle, is thought to resemble the wild cattle from which modern domestic breeds have been produced.

Fig. 7.1 shows one of the Chillingham cows and Fig. 7.2 shows a modern cow.



Fig. 7.1 Chillingham cow



Fig. 7.2 modern cow

(a) (i) Suggest **one** feature of the Chillingham cow that is likely to have changed during selective breeding to increase productivity.

.....

..... **[1]**

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(ii) Describe how modern cattle have been produced from less productive wild cattle ancestors.

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..... **[4]**

Question 7 continues on page 20

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(b) Many people in the UK consume large amounts of milk and beef.

Over-consumption of milk and beef can lead to an unbalanced diet and malnutrition.

(i) Define the term *balanced diet.*

.....

.....

..... **[2]**

(ii) Milk and beef both contain triglyceride molecules.

Fig. 7.3 represents a triglyceride molecule.

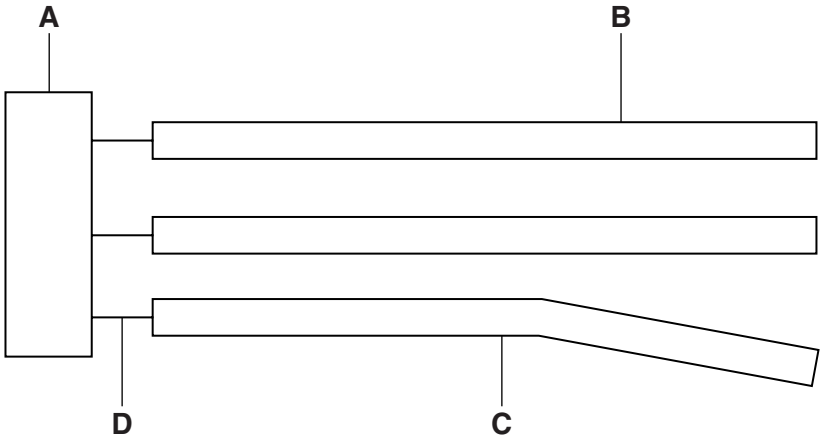


Fig. 7.3

Identify **A**, **C** and **D** on Fig. 7.3.

A .....

C .....

D .....

[3]

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(iii) Suggest and explain why over-consumption of milk and beef can lead to malnutrition.

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..... **[3]**

(c) In the past, beef was preserved by adding salt.

Explain how salting preserves food.

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.....

..... **[3]**

[Total: 16]

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8 Vaccination can provide immunity to disease.

(a) Complete the following passage by using the most appropriate term from the list.

active **antigen(s)** **double-helix** **membrane(s)** **memory**
mutation **passive** **phagocytic** **receptor(s)**
species **specific** **strand** **strain** **white blood**

Some vaccines contain a dead or weakened form of a pathogen. The ..... on the cell surface of the pathogen are still able to trigger the production of ..... antibodies in the person being vaccinated. Cells called ..... cells are also produced, which retain the ability to divide and produce the antibodies quickly, should the pathogen return.

A new ..... of pathogen can arise if there is a ..... in the DNA of the pathogen. If this happens, the original vaccine is not likely to be effective.

[5]

(b) The term *immunity* is often used when describing how vaccines work.

In a piece of school homework a student wrote:

"Bacteria can evolve quickly and many are now immune to antibiotics."

Explain why the student's use of the word 'immune' was incorrect.

.....

.....

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.....

.....

..... **[3]**

[Total: 8]

END OF QUESTION PAPER

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ADDITIONAL ANSWER SPACE

If additional answer space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margins.

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ADDITIONAL ANSWER SPACE

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Unit **F212:** Molecules, Biodiversity, Food and Health

Advanced Subsidiary GCE

Mark Scheme for June 2014

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All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

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These are the annotations, (including abbreviations), including those used in scoris, which are used when marking

Annotation	Meaning
BP	Blank Page – this annotation **must** be used on all blank pages within an answer booklet (structured or unstructured) and on each additional page where there is no candidate response.
	Correct answer
	Incorrect response
BOD	Benefit of Doubt
NBOD	Not Benefit of Doubt
ECF	Error Carried Forward
GM	Given mark
	Underline (for ambiguous/contradictory wording)
	Omission mark
I	Ignore
	Marking point partially met
QWC+	QWC* element met
CON	A response that would gain credit is associated with some clearly incorrect science. Do not award the mark.

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Question			Answer	Mark	Guidance
1	(a)	(i)	fins ; streamlining / streamlined shape ;	1 max	**Mark the first answer.** If the answer is correct and another answer is given that is incorrect or contradicts the original answer, then = **0 marks** **ACCEPT** reasonable attempt to describe streamlined shape **ACCEPT** aerodynamic **ACCEPT** articulated / flexible , spine
1	(a)	(ii)	eyes on top of head ;	1	**Mark the first answer.** If the answer is correct and a further answer is given that is incorrect or contradicts the correct answer then **= 0 marks** **ACCEPT** the position of the eyes / eyes that can see above **IGNORE** eyes facing forward **IGNORE** fin **IGNORE** eyes close together **IGNORE** refs to shape
1	(b)		**1** (cellulose) cell wall ; **2** chloroplast(s) ; **3** (large / permanent) vacuole ; **4** starch granules ;	2	**Mark the first answer on each prompt line.** If the answer is correct and another answer is given that is incorrect or contradicts the original answer, then = **0 marks** **2 CREDIT** plastids / dictysomes / many small Golgi **3 IGNORE** chlorophyll **3 CREDIT** tonoplast **4 CREDIT** druses / raphides / crystalline inclusions / Ca oxalate

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Question			Answer	Mark	Guidance
1	(c)		**1** (similarities / differences in) genes / genetics / DNA / RNA / molecules / biochemistry ; **2** (similarities / differences in) nucleotide / base , sequence / order ; **3** (similarities / differences in) cytochrome c / haemoglobin / ATP synthase / RNA polymerase; **4** (similarities / differences in) sequence / order , of amino acids (in proteins) ; **5** *idea that* similarities between any of the above implies (close) relationship ; **ora**	5 max	**1 ACCEPT** molecular / biochemical evidence **5 CREDIT** if their genes are similar they must share a recent common ancestor **5 AWARD** as a general statement or with an example, e.g. 'chimps and humans share large proportion of DNA and this means that they are related gets mp **1** and **5.** 'Chimps and humans are closely related' = 0 marks unless linked to a marking point from 1 – 4.
			6 *idea of* evolution within human history ; **7** similarities in / differences in / comparison of , embryology / morphology / anatomy / physiology / behaviour ;		**6 CREDIT** in the context of an example of evolution in action, e.g. MRSA resistance to antibiotics **or** as a general statement **6 CREDIT** selective breeding (artificial selection) example **7 CREDIT e.g.** similar finches occupying different niches on neighbouring Galapagos islands **7 CREDIT** e.g. vertebrate pentadactyl limb etc. **7 ACCEPT** idea of vestigial organs ; **7 IGNORE** appearance / features / adaptations
			QWC **;** One mark from 1-4 and 1 mark from 6-7	1	Marking point **5** is not part of QWC
				6	
			Total	**10**	

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Question			Answer	Mark	Guidance
2	(a)		(works) outside cells **;**	1	**ACCEPT** secreted / AW , from cells **ACCEPT** works in named extracellular environment e.g. digestive tract **IGNORE** doesn't work in cells
2	(b)	(i)	time / time taken **;**	1	**Mark the first answer.** If the answer is correct and another answer is given that is incorrect or contradicts the original answer, then **= 0 marks** **ACCEPT** 'how long it took …'

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Question			Answer	Mark	Guidance
2	(b)	(ii)	*linear part of the graph means…* **1** more (successful) collisions with (amylase) active site (at increasing starch concentration) **; ora** **2** more ESC (at increasing starch concentration) **; ora** **3** so more product formation in a given time (at increasing starch concentration) **; ora** *curve / plateau , means…* **4** all / most , active sites (of amylase) are occupied **;** **5** enzyme / amylase , working , at / near, maximum rate / V_{max} **;** **6** (so) further increase in starch concentration has no effect (on rate) **;** **7** enzyme concentration , is / becomes , limiting factor **;**	5 max	**ACCEPT** glucose / maltose for product throughout **ACCEPT** substrate for starch throughout **1 ACCEPT** few(er) active sites occupied at low starch concentrations **2 ACCEPT** ESC formed more easily **3 AWARD** only if linked to the context of marking points **1 or 2** e.g. **'**more product formation in a given time because of more collisions with the enzyme' gets mp3 but not mp1 because active site not mentioned **3 IGNORE *rate*** as this is a description of graph **4 ACCEPT** all active sites are full of substrate **5 ACCEPT** enzyme at full capacity **6** Must link to **4** or **5** **6 AWARD** only if mp 4 or 5 given **6 DO NOT CREDIT** rate decreases **7 ACCEPT** the increasing part of the graph is because starch concentration is the limiting factor

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Question			Answer	Mark	Guidance
2	(b)	(iii)		3 max	The mark points refer to a constant pH preventing damage to the enzyme. **CREDIT** throughout the appropriate marking point for an answer that describes what would happen if the pH changed.
			1 (so) charges in active site do not change **; ora**		
			2 (so) hydrogen / ionic **,** bonds unaffected **; ora**		**2 DO NOT CREDIT** peptide / disulphide **,** bonds break **2 DO NOT CREDIT** in context of heat / vibration **2 IGNORE** hydrophobic / hydrophilic
			3 (so) tertiary structure / 3D shape / active site **,** unaltered **; ora**		**3 IGNORE** ref to denaturing active site **3 IGNORE** tertiary structure breaks **3 ACCEPT** tertiary structure affected **3** Cannot be inferred from mp5 – must be stated
			4 (so) enzyme / tertiary structure **,** does not <u>denature</u> **;** **ora**		**4 IGNORE** ref to denaturing active site **4 DO NOT CREDIT** kill / die
			5 (so) substrate , fits / is complementary shape to , <u>active site</u> **; ora**		**5 IGNORE** enters / binds with
			6 so the results are <u>valid</u> / as the <u>rate</u> (of reaction) will vary if pH varies / so that only one (independent) variable is changed ;		**6 IGNORE** fair test / reliable / accurate

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<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Mark</th><th>Guidance</th></tr>
<tr><td>2</td><td>(b)</td><td>(iv)</td><td>temperature (of the reaction mixture) ;
enzyme / amylase , concentration ;

(total) volume of (reaction) solution ;

concentration of , cofactors / chloride ions / Cl^- ;</td><td>2 max</td><td>Mark the first answer on each prompt line. If the answer is correct and another answer is given that is incorrect or contradicts the original answer, then = 0 marks
DO NOT CREDIT substrate / starch , concentration (as this is the independent variable)

DO NOT CREDIT amount

ACCEPT volume of enzyme solution
DO NOT CREDIT amount

ACCEPT concentration of coenzymes

IGNORE time / agitation / inhibitors</td></tr>
<tr><td>2</td><td>(c)</td><td>(i)</td><td>
<table>
<tr><th>Amylose</th><th>Cellulose</th></tr>
<tr><td>coiled</td><td>no coiling</td></tr>
<tr><td>(contains) α / alpha / A / a ,-glucose</td><td>(contains) β / beta / B / b , -glucose ;</td></tr>
<tr><td>α / alpha / A / a 1-4 glycosidic bonds</td><td>β / beta / B / b 1-4 glycosidic bonds ;</td></tr>
<tr><td>all , monomers / AW , in same orientation</td><td>alternate monomers at , 180° / AW , to each other ;</td></tr>
<tr><td>granular / not fibrous</td><td>fibrous / not granular ;</td></tr>
<tr><td>H bonds within molecule / no (H) bonds (between molecules)</td><td>(H) bonds between adjacent molecules ;</td></tr>
</table>
</td><td>3</td><td>Mark the first 3 responses
AWARD 1 mark for each correct row irrespective of boxes
Three correct rows of responses written within the same box can be awarded 3 points.

ACCEPT every second one is flipped

ACCEPT fibres / microfibrils / fibrils / macrofibrils
DO NOT CREDIT myofibrils
ACCEPT grains

ACCEPT ‘(cross)links’ as AW for ‘bonds’</td></tr>
</table>

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Question			Answer	Mark	Guidance
2	(c)	(ii)	(tensile) strength / strong ; (H) bonds / links , can form (between adjacent fibrils) ; insoluble ;	2 max	**ACCEPT** mechanical strength **IGNORE** fibrous / rigid **ACCEPT** fibres / microfibrils / fibrils / macrofibrils **IGNORE** refs to bonding with water **IGNORE** ionic / myofibrils **ACCEPT** crosslinks **DO NOT CREDIT** peptide / covalent / glycosidic / disulfide etc
			Total	**17**	

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Question			Answer	Mark	Guidance
3	(a)		Nymphaea ;	1	**NOTE**: the first letter must clearly be in upper case and the others in lower case and the spelling correct
3	(b)		**1** (natural) habitat / ecosystem , lost due to / destroyed by **/** under threat from , climate change / (named) human activity **;** **2** number / population , (in natural habitat) is very low **;** **3** *idea that* in the wild, (sexual) reproduction is difficult (if numbers are low) **; ora** **4** (breeding *ex situ* can) maintain , the gene pool / genetic / allelic , diversity**; ora** **5** *idea that* allows protection from **,** grazers / herbivores / plant collectors / competing species **; ora** **6** *idea of* protection from **,** pathogen / parasites / disease **; ora**	3 max	**IGNORE** can be in optimum conditions throughout **1** The essence of this marking point is habitat loss plus reason. Award tick when both these ideas have been seen. **1 ACCEPT** natural disaster / deforestation , as reason for habitat loss **2 IGNORE** reference to , extinct / endangered **3 ACCEPT** e.g. fertilization can be carried out using a paintbrush **5 ACCEPT** habitat contains organisms that are a threat **5 ACCEPT** protection from , predators / poachers / hunters **6 ACCEPT** pests

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Question			Answer	Mark	Guidance
3	(c)		**1** can be collected with minimal damage to (wild) , population / habitat / ecosystem ; **2** take up little space / larger numbers can be stored **;** **ora** **3** can store great(er) , genetic / allelic , diversity **; ora** **4** low(er) maintenance / manpower costs / AW **; ora** **5** easy / cheaper, to transport / AW **; ora** **6** *idea of* remaining viable for long periods **; ora** **7** less , susceptible / vulnerable , to, disease / pests / environmental change **; ora** **8** *idea that* prevents fertilisation by undesired pollen **;**	3 max	**Mark as prose. Ignore numbered lines**. **2 ACCEPT** easier to store a large amount **4 CREDIT** 'cheaper' only if supported by an explanation **4 IGNORE** easier to keep unqualified **4 ACCEPT** less labour-intensive **4 DO NOT CREDIT** no maintenance costs **6 CREDIT** description / example – e.g. kept dry so that they do not rot / regular germination and new seed production **6 IGNORE** 'last a long time' unqualified **6 ACCEPT** 'stay , alive / fertile , for a long time' **7 ACCEPT** the adult plant might have a disease **7 IGNORE** prevents

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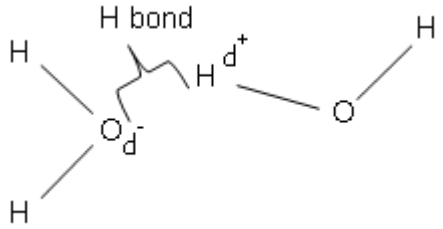
Question			Answer	Mark	Guidance
3	(d)		**1** (use of) quadrat **;**	4 max	**1 ACCEPT** description of a quadrat / point frame **1 IGNORE** quadrant
					AWARD either a or b *for both marking points* ***2*** *and* ***3****. Do not mix a and b marks. If both a and b marks are present ignore the lower scoring letter.*
			2a random (sampling) **;**		**2a ACCEPT** bits of paper in a hat / random number generator **2a DO NOT CREDIT** throw
			3a placing measuring tapes (at right angles) / use grid **;** **OR** **2b** (use of) transect **;** **3b** (quadrat / point frame) placed at regular intervals **;**		**3a ACCEPT** e.g. bottom left hand corner of quadrat placed at coordinate / two students walk in a straight line from each tape measure **3b ACCEPT** systematic sampling
			4 (use of identification) key **;**		
			5 example / detail , of method used to determine abundance **;**		**5 ACCEPT** percentage cover / percentage frequency / number of hits with point frame / ACFOR **5 ACCEPT** strategy for dealing with plants half in or out of quadrat **5 IGNORE** 'count' without further clarification
			6 repeat many times / *idea of* considering appropriate number of samples **;**		**6 ACCEPT** calculate running mean **6 IGNORE** several / a few **6** If number state must be at least 5
			7 sample / AW , at different , seasons / times of year **;**		**7 ACCEPT** throughout the year

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Question			Answer	Mark	Guidance
3	(e)			3 max	**IGNORE** prompt lines and mark as prose
			1 reason for not having found all species ;		**1 ACCEPT** e.g. some (named) habitats inaccessible / microscopic species missed / low numbers of individuals / habitat unexplored / some habitats rare / species are nocturnal
			2 may have become extinct , recently / since recording **;**		**2 ACCEPT** organisms constantly become extinct
			3 evolution is on-going / new species are being formed / AW **;**		**3 ACCEPT** new species are being created
			4 *idea that* some (species) difficult to distinguish / some species may be reclassified / AW **;**		**4 ACCEPT** e.g. might mistake several species for one **4 ACCEPT** scientists might disagree about whether it is a species or not.
			Total	**14**	

Question			Answer	Mark	Guidance
4	(a)	(i)	*primary* B **and** D **;**	1	**DO NOT CREDIT** if another letter is shown
		(ii)	*secondary* A **and** E **;**	1	**DO NOT CREDIT** if another letter is shown
		(iii)	*tertiary* F **and** G **;**	1	**DO NOT CREDIT** if another letter is shown
		(iv)	*quaternary* C**;**	1	**DO NOT CREDIT** if another letter is shown

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Question			Answer	Mark	Guidance
4	(b)	(i)	**1** between O and H (of adjacent molecules) **;** **2** between , electropositive / δ^+ / delta$^+$ (H), and , electronegative / δ^- / delta$^-$ (O) **;** **3** water molecule **,** is polar / has charge separation **;**	3	**1 DO NOT CREDIT** O/H molecules **2 ACCEPT** slightly , positive / negative **2 IGNORE** oxygen is negative / hydrogen is positive **2 DO NOT CREDIT** ions **AWARD** mp **1** and **2** for diagram below, i.e. H bond can be drawn as dotted or dashed or labelled, but **IGNORE** solid line **DO NOT AWARD** mark if diagram contradicts text  **3 ACCEPT** electrons pulled closer to oxygen atom / water is a dipole **3 IGNORE** electronegative / electropositive **3 IGNORE** oxygen is negative / hydrogen is positive **3 DO NOT CREDIT** ions

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Question			Answer	Mark	Guidance
4	(b)	(ii)	**1** medium for (metabolic) reactions **;**	3 max	**1 ACCEPT** reactions can happen in water **1 ACCEPT** supports metabolic reactions
			2 (because) allows (named) ionic compound(s) to separate ;		
			3 transport **;**		
			4 **two** named transport , systems / media **OR** one example of a transport , medium / system , with a named example of what is transported ;		**4 IGNORE** nutrients **5 ACCEPT** apoplast / sap / blood / symplast / vacuolar pathway / blood / lymph / xylem / phloem / tissue fluid / CSF
			5 (organisms can) absorb / take in , (named) minerals / ions / (named) gas / food **;**		**5 IGNORE** nutrients / substances **5 IGNORE** get / obtain
			6 able to dilute toxic substances **;**		**IGNORE** refs to osmosis
			Total	**10**	

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Question			Answer	Mark	Guidance
5	(a)		characteristics / features / AW , are passed on to / inherited (by the next generation) **;**	1	**IGNORE** genes / alleles / DNA as question asks about Darwin's conclusion **ACCEPT** 'appearance' for features **DO NOT CREDIT** answers that only refer to beneficial characteristics (as Darwin's other observations would need to be considered to arrive at this conclusion)
5	(b)		**1** B **and** C **and** D are more closely related (to each other than to A) **; ora** **2** *idea that* A is in different (taxonomic) group (from other 3) **; ora** **3** B **and** C **and** D , share more , recent common ancestor **;** **4** phylogeny / evolution , of B **and** C **and** D diverged at same point **; ora**	2 max	**IGNORE** references to relationship with organism (1) **1 IGNORE** 'B, C and D are more similar' as this could refer to appearance rather than relationship **2 CREDIT** named taxonomic group **3 IGNORE** genes etc.
5	(c)		fits evidence **;** *idea of* more **,** evidence / research (since nineteenth century) **;**	1 max	**CREDIT** examples, e.g. DNA revolution / more fossils **ACCEPT** improved technology / molecular evidence **IGNORE** 'the theory has been proved' **IGNORE** Darwin provided more evidence **ACCEPT** changes in religious belief
5	(d)	(i)	code for (one or more) polypeptide(s) **;**	1	**ACCEPT** protein **IGNORE** amino acid sequence

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Question			Answer	Mark	Guidance
5	(d)	(ii)		5 max	**AWARD** marks from clearly annotated diagram
			1 double stranded **;**		**1 ACCEPT** double helix **or** two , polynucleotides / strands / chains **or** antiparallel strands **1 IGNORE** one old and one new strand
			2 each / both (strands) act as template **;**		**2 IGNORE** either **NOTE** 'there are 2 strands which act as templates' = 2 marks (mp 1 and 2)
			3 hydrogen bonds , easily , break / form , between bases ;		**3 ACCEPT** weak H bonds between bases break **3 IGNORE** refs to H bonds , breaking / forming , without qualification that the bonds are weak or , form / break , easily
			4 complementary (specified) base , pairing / AW **;**		**4 IGNORE** complementary nucleotides unless qualified with examples of base-pairing
			5 purine (only able to) bind to pyrimidine **;** **6** (due to) different sizes of purines and pyrimidines **;**		
			7 hydrogen bonding different between A & T **and** C & G **or** 3 H bonds between C & G **and** 2 H bonds between A & T **;**		**7 ACCEPT** names of bases with phonetic spellings **7 DO NOT CREDIT** thyamine **7ACCEPT** A=T **and** C≡G without reference to hydrogen bonds

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Question			Answer	Mark	Guidance
5	(e)	(i)	<u>speciation</u> ;	1	
5	(e)	(ii)	*idea that* different islands have different , selection pressures / habitats / environments / vacant niches **; ora** *idea of* isolation **; ora**	1 max	**CREDIT** ' the Galapagos have a wider range of habitats' **IGNORE** islands have different habitat(s) from the mainland e.g. the islands are separated from the mainland / no gene flow / geographic barrier / reproductive barrier **ACCEPT** allopatric (speciation) **IGNORE** sympatric **IGNORE** refs to succession or human habitat destruction on the mainland as the question is about evolution
			Total	**12**	

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Question			Answer	Mark	Guidance
6	(a)		mental and physical well-being **;** absence of disease **;**	2	**IGNORE** social **ACCEPT** "not just the absence of disease"
6	(b)	(i)	185.2 **; ;**	2	**Correct answer = 2 marks** **CREDIT** either in the table or seen in the working space answer should be given to 1dp (to be consistent with the other calculated data) If answer incorrect or given to the incorrect number of d.p. **ALLOW** 1 mark for 185 / 185.18 / 185.19 / 185.185 / 185.1 seen anywhere
6	(b)	(ii)	**1** death from , CHD / lung cancer / both , increased (in smokers) ; **2** CHD has bigger increase in number (of deaths) due to smoking (than lung cancer) ; **ora** **3** lung cancer has bigger , relative / percentage , increase (in deaths) due to smoking (than CHD) ; **ora**	2 max	**IGNORE prompt lines – mark as prose** **1 ACCEPT** AW **1 IGNORE** figures – must be a comparative statement **2 ACCEPT** implication from correct (1388 and 360) calculated increases **3 IGNORE** figures – must be a comparative statement **3 IGNORE** bigger impact

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Question			Answer	Mark	Guidance
6	(c)			6 max	***N** marking points*
			N1 nicotine ;		**N1 DO NOT CREDIT** if any **N** mark is associated with a chemical other than nicotine
			N2 increases stickiness of platelets ;		**N2 ACCEPT** makes platelets sticky
			N3 thrombosis / formation of blood clot ;		**N3 ACCEPT** thrombus formation
			N4 causes release of adrenaline ;		
			N5 causes constriction of , arterioles / small arteries ;		**N5 IGNORE** narrowing of lumen
			N6 reduced , blood flow / oxygen supply , to (named) extremities ;		
					***C** marking points*
			C7 carbon monoxide / CO ;		**C7 DO NOT CREDIT** if any **C** mark is associated with a chemical other than carbon monoxide
			C8 combines (permanently) with haemoglobin / forms carboxyhaemoglobin ;		**C8 IGNORE** carbamino
			C9 reduced oxygen carrying capacity of blood ;		**C9 ACCEPT** reduced amount of oxygen in blood **C9 IGNORE** 'less oxygenated blood is delivered to tissues' as this could imply reduced cardiac output

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Question			Answer	Mark	Guidance
			10 increased , heart rate / blood pressure ; **11** damage to, lining / endothelium , (of blood vessels) ; **12** atherosclerosis / atheroma ; **13** coronary heart disease / CHD / heart attack / stroke / myocardial infarction / MI / angina **;**		**10 IGNORE** heart must work harder **11 ACCEPT** epithelium **12 IGNORE** plaques **13 IGNORE** conary / chronic / part of heart dying / cardiac arrest / heart failure
			QWC - **N1 and C7 plus** another **N** mark **or C** mark **and no** discussion of tar	1	**DO NOT AWARD** QWC if candidate discusses a lung disease or any non-cardiovascular effects **DO NOT AWARD** QWC tar is *discussed* at all **IGNORE** nicotine is addictive **IGNORE** 'tar' if it appears as a list of chemicals
				7	
			Total	**13**	

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Question			Answer	Mark	Guidance
7	(a)	(i)	udder size / milk production / meat production / growth rate / muscle (as proportion of body mass) **;**	1	**ACCEPT** number of offspring per birth **IGNORE** unqualified references to size **IGNORE** references to , horns / placidity , unless the answer links this with more energy diverted to productivity
7	(a)	(ii)	**1** artificial <u>selection</u> **;**	4 max	**1 IGNORE** 'selective breeding' as mentioned in part (i)
			2 (selection of) named desired feature (linked to productivity) **;**		**2 ACCEPT** e.g. weigh them / measure them / see who produces the most milk / choose the biggest / udder size **2 IGNORE** select the best **2 CREDIT** marker assisted selection / progeny testing **2 DO NOT CREDIT** if clearly not in the context of selective breeding, e.g. change their diet to make them produce more milk'
			3 (cross)breed , selected / AW , cattle ;		**3 ACCEPT** 'parents' as AW for 'cattle' **3 ACCEPT** 'reproduce / mate / in<u>ter</u>breed' as AW for 'breed' **3 DO NOT CREDIT** inbreed **2&3** 'breed cattle with high milk productivity = 2 marls
			4 (cross)breed**,** best / selected / AW, offspring **;**		**4 IGNORE** 'crossbreed offspring' without qualification. Answer must imply some selection of offspring.
			5 over (many) generations **;**		**5 DO NOT CREDIT** few **5 ACCEPT** several
7	(b)	(i)	(contains) all / each , of , nutrients / food groups **;**	2	**ACCEPT** a list of food groups that contains at least – protein, fat, carbohydrate, vitamins, minerals **IGNORE** components
			in correct proportions / AW **;**		**ACCEPT** right amount of

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Question			Answer	Mark	Guidance
7	(b)	(ii)		3	**Mark the first answer on each prompt line.** If the answer is correct and another answer is given that is incorrect or contradicts the original answer, then **= 0 marks**
			A glycerol **;**		**A IGNORE** molecule
			C unsaturated fatty acid **;**		**C ACCEPT** unsaturated hydrocarbon , tail / chain
			D ester , bond / link **;**		**D IGNORE** covalent

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Question			Answer	Mark	Guidance
7	(b)	(iii)	**1** contains **,** large amounts of energy / more energy than individual needs **;** **2** increased , fat / lipid , deposition / storage **;** **3** (associated with) obesity **;** **4** (lots of meat and dairy in diet could mean) lack of other (named) food groups / AW **;**	3 max	**1 ACCEPT** contains , too many calories / excess energy **1 ACCEPT** contains a lot of saturated fat **2 ACCEPT** in context of arteries and adipose tissue **2 ACCEPT** cholesterol / LDL as AW for fat **2 IGNORE** build up **3 IGNORE** CHD (as not malnutrition) **4 ACCEPT** nutrients as AW for food groups **4 IGNORE** unbalanced diet **4 IGNORE** fat / protein
7	(c)		**1** reduces , water potential / Ψ , outside , microbial / bacterial / fungal , cells **;** **2** (microbes) lose water **and** cannot , reproduce / survive / carry out metabolic reactions / AW **;** **3** water moves by osmosis **;**	3	**1** Cannot be implied from references to water potential gradient **1 ACCEPT** reduces beef water potential **1 IGNORE** solute potential **1 IGNORE** viruses **2 ACCEPT** bacteria lose water and die **2 AWARD** only in context of microbes dehydrating **2 IGNORE** viruses **2 IGNORE** beef losing water so microbes cant reproduce **3 ACCEPT** in any correct water potential context
			Total	**16**	

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Question			Answer	Mark	Guidance
8	(a)		antigen(s) ; specific ; memory ; strain ; mutation ;	5	
8	(b)		**1** immunity involves / bacteria do not have , lymphocytes / white blood cells / antibodies / memory cells / plasma cells / an immune system ; **2** (correct term is) resistant ; **3** bacteria are unicellular / only multicellular organisms (can) have an immune response;	3	
			Total	**8**	

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APPENDIX 1 **Mark Scheme Conventions**

The following conventions appear in the Mark Scheme

1. Bracketed words. The words in brackets are there to 'set the scene' and indicate the context in which the answer is expected. They do not need to appear. Award the mark as long as the statement in the brackets is not contradicted.

2. Solidus /. A solidus indicates alternative ways that a mark might be gained for a given Mark Point.

3. Use of the comma in a mark point. This indicates that some information from either side of the comma or commas is needed. It is used in conjunction with the solidus.

4. Underlining.
   - solid underline. The word or part of word underlined is required but minor mis-spellings are acceptable as long as the word is phonetically the same
   - wavy underline. This indicates that whilst the word underlined is not precisely needed, alternative responses need to be closely related in meaning or be a clear description.

5. *idea of.* This is used as a prefix to marking points where there may be a fairly wide range of responses which cover the essence of the required response. This often requires examiner judgement. These often, but not exclusively, appear in questions such as those related to environmental or health issues.

6 Awarding of QWC mark. Every time an element of QWC is seen put QWC in the left hand margin. When all QWC criteria are met, put a tick next to the final QWC. If QWC not achieved, put a cross next to the pencil icon.

7. ora. Or reverse argument.

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RECOGNISING ACHIEVEMENT

Monday 3 June 2013 – Morning

AS GCE BIOLOGY

F212/01 Molecules, Biodiversity, Food and Health

Candidates answer on the Question Paper.

OCR supplied materials:
- Insert (inserted)

Other materials required:
- Electronic calculator
- Ruler (cm/mm)

Duration: 1 hour 45 minutes

F21207061 3

F 2 1 2 0 1

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined pages at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **100**.
- Where you see this icon you will be awarded marks for the quality of written communication in your answer.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.
- This document consists of **24** pages. Any blank pages are indicated.

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Answer **all** the questions.

1 **(a)** Amino acids form part of the structure of proteins.

(i) State the name given to the sequence of amino acids in a protein molecule.

..... **[1]**

(ii) Draw the **general structure** of an amino acid molecule in the space below.

[3]

(b) Collagen is an important fibrous protein which forms part of the wall of blood vessels.

(i) State **one** property of collagen that makes it a useful component of blood vessel walls.

..... **[1]**

(ii) Describe the **structure** of the collagen molecule.

.....

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..... **[6]**

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(c) Another protein that is important in mammals is haemoglobin.

(i) State **one** function of haemoglobin.

.....

..... **[1]**

(ii) Haemoglobin contains a prosthetic group known as haem.

Collagen does not contain a prosthetic group.

Describe **three** other ways in which the structure of haemoglobin differs from that of collagen.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

[Total: 15]

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2 **(a)** Alcohol dehydrogenase is a protein molecule that is present in the liver. The molecule breaks down alcohols and other chemicals that would otherwise be toxic to the body.

Name the group of biological molecules to which alcohol dehydrogenase belongs.

..... **[1]**

(b) In 1985, health concerns were raised when the compound diethylene glycol (DEG) was detected in samples of wine. The DEG had been added, illegally, to make the wine taste sweeter.

In the liver, DEG is broken down by alcohol dehydrogenase to form a toxic product. Alcohol dehydrogenase also breaks down ethanol, the key ingredient in alcoholic drinks such as wine, to form a non-toxic product.

Fig. 2.1 shows the structures of DEG and ethanol.

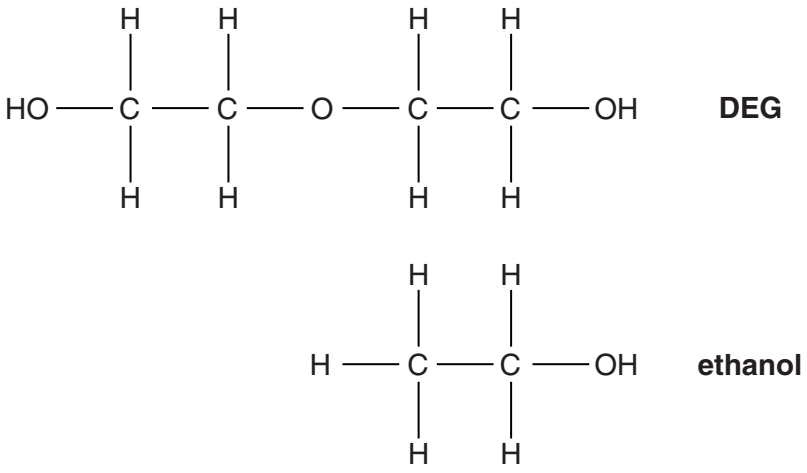


Fig. 2.1

(i) Using the information in Fig. 2.1, explain why alcohol dehydrogenase is able to break down **both** ethanol and DEG.

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..... **[3]**

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(ii) Suggest why DEG-contaminated wines with a high ethanol content may result in less DEG poisoning than contaminated wines with a low ethanol content.

.....

.....

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.....

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.....

.....

..... **[3]**

[Total: 7]

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3 **(a)** Phagocytes form part of the body's non-specific response to disease.

Fig. 3.1, **on the insert**, shows a photograph of some blood cells.

(i) Identify which of the cell(s) labelled **A, B** and **C**, are phagocytes.

..... **[1]**

(ii) Why are phagocytes described as a secondary defence against pathogens?

.....

.....

..... **[1]**

(iii) Why is the response involving phagocytes regarded as **non-specific**?

.....

.....

..... **[1]**

(iv) Explain how phagocytes, such as those shown in Fig. 3.1, are able to pass from the blood into the tissue fluid.

.....

.....

.....

..... **[2]**

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(v) Bacterial pathogens initially attach to receptors on the surface of phagocytes.

Describe the process by which a pathogen is destroyed after it has become attached to the surface of a phagocyte.



In your answer you should describe clearly the sequence of events that takes place.

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..... **[7]**

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(b) The infective agent that causes TB is not easily destroyed by phagocytes.

(i) Name the infective agent that causes TB.

..... **[1]**

(ii) Describe how the infective agent that causes TB is transmitted from one individual to another.

.....

.....

.....

..... **[2]**

(c) The World Health Organisation (WHO) collects data about diseases worldwide.

Table 3.1 shows data published by the WHO about the incidence of TB in the years 2000 and 2008 for four different income groups.

Income group	Incidence of TB per 100 000 population	
	In 2000	In 2008
Low	280	280
Lower middle	150	150
Upper middle	100	110
High	17	14

Table 3.1

(i) Using the information in Table 3.1, compare the data for 2000 and 2008 in the four income groups.

.....

.....

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.....

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.....

.....

..... **[3]**

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(ii) The highest incidence of TB is associated with the low income group.

Suggest **three** reasons why the incidence of TB is higher in the low income group.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

[Total: 21]

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4 On a biology field trip, a pair of students collected some data about plant species in an area of ash woodland. Their results are shown in Table 4.1.

Species	**Number of individuals (*n*)**	***n*/*N***	**$(n/N)^2$**
Dog's mercury	40		
Wild strawberry	13	0.13	0.0169
Common avens	43		
Wood sorrel	4		
	N =		$\Sigma(n/N)^2$ =
			$1-(\Sigma(n/N)^2)$ =

Table 4.1

(a) (i) Use the information in the table to work out the Simpson's Index of Diversity (D) for the area of woodland sampled using the formula:

$$D = 1-(\Sigma(n/N)^2)$$

Where: n = number of individuals of a particular species.
N = total number of individuals in all species.
Σ = sum of.

Complete Table 4.1.

You may use the space below for your working. **[3]**

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(ii) Simpson's Index of Diversity takes into account both species richness and species evenness.

In a school exercise book a student wrote the following definitions:

> Species richness is a measure of the amount of species in an area.
>
> Species evenness shows how many individuals there are of a species in an area.

The teacher did not award a mark for either of these statements.

Suggest how each statement could be improved.

Species richness .....

.....

Species evenness .....

.....

[2]

(iii) If the value for Simpson's Index of Diversity is high, this indicates that the biodiversity of the habitat is high.

Outline the **implications** for a habitat if the Simpson's Index of Diversity is **low**.

.....

.....

.....

..... **[2]**

(b) When collecting data on the field trip, the students placed quadrats in 15 locations and calculated a mean number of plants for each species.

Suggest two **other** steps they could have taken to ensure that their value for Simpson's Index of Diversity was as accurate as possible.

1 .....

.....

2 .....

.....

[2]

[Total: 9]

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5 **(a)** Fig. 5.1 shows part of a DNA molecule.

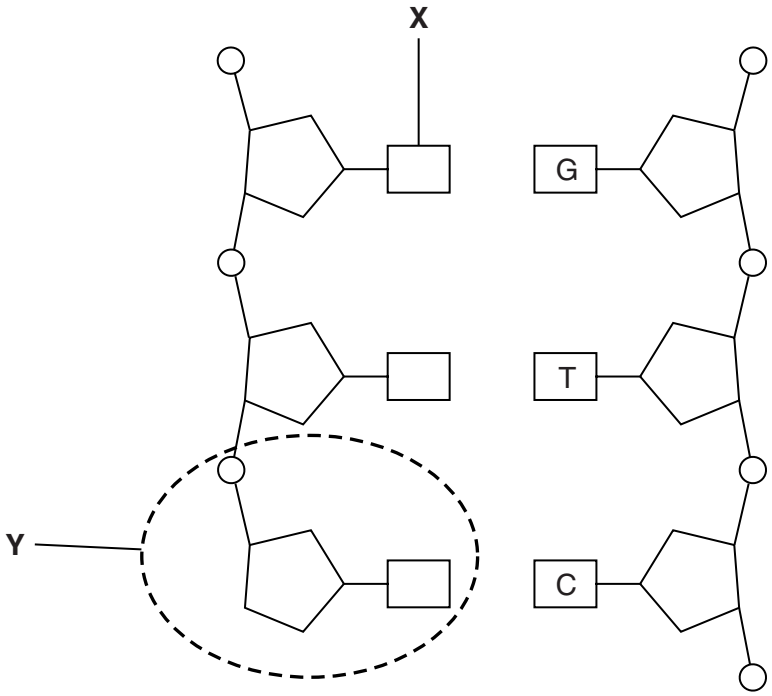


Fig. 5.1

(i) Name the parts of the molecule represented by the letters **X** and **Y**.

X .....

Y .....

[2]

(ii) **Complete the diagram in Fig. 5.1** by drawing hydrogen bonds to connect the two strands.

The hydrogen bonds should be drawn on Fig. 5.1. **[2]**

(iii) Complete the following paragraph by using the most appropriate term(s).

A gene is a section of DNA that codes for the production of a ..... .

The molecule that copies a gene and carries the information to a .....

is called RNA. **[2]**

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(iv) State **two** ways in which a diagram of part of an RNA molecule would appear different from the DNA molecule shown in Fig. 5.1.

1 .....

.....

.....

2 .....

.....

..... **[2]**

(b) DNA replication takes place during interphase of the cell cycle. It occurs by a semi-conservative mechanism.

(i) Explain why DNA replication is considered to be semi-conservative.

.....

.....

.....

.....

..... **[2]**

(ii) Explain why complementary base-pairing is important in DNA replication.

.....

.....

.....

.....

.....

..... **[2]**

Question 5(c) begins on page 14

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(c) In 1958, two scientists, Meselson and Stahl, conducted an investigation into DNA replication.

- Bacteria were grown in a food source that contained only the 'heavy' isotope of nitrogen, ^{15}N. After many generations, the bacterial DNA contained only the 'heavy' form of nitrogen.
- Some of the bacteria were then transferred to another food source containing only the normal, 'lighter' form of nitrogen, ^{14}N.
- DNA was extracted from the bacteria and centrifuged. (When a solution is centrifuged, the heavier, more dense molecules tend to settle nearer the bottom of the tube.)

Some of the results from the experiment are shown in Fig. 5.2.

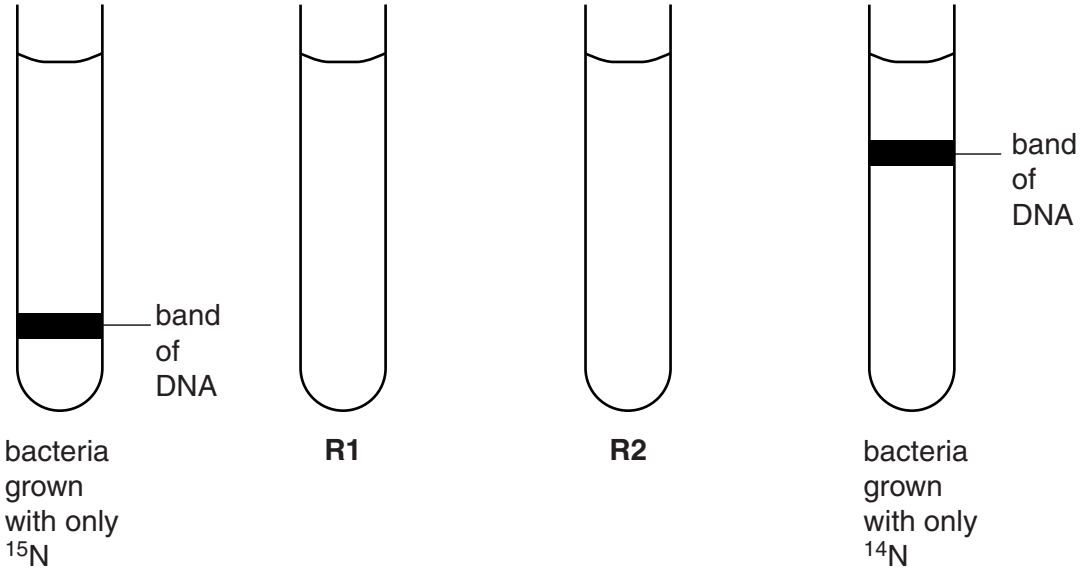


Fig. 5.2

(i) In Fig. 5.2, the tube labelled **R1** represents the results for DNA extracted from bacteria that had been **transferred** from the ^{15}N to the ^{14}N food source and left long enough for their DNA to replicate **once** only.

Draw **one** band on tube **R1** in the position you would expect the DNA to appear **after** centrifuging.

Draw the band on Fig. 5.2. **[1]**

(ii) In Fig. 5.2, the tube labelled **R2** represents the results for DNA obtained from bacteria that had been **transferred** from the ^{15}N to the ^{14}N food source and left long enough for their DNA to replicate **twice**.

Draw **two** bands on tube **R2** in the positions you would expect the DNA to appear **after** centrifuging.

Draw the bands on Fig. 5.2. **[1]**

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(d) The technique of centrifugation used by Meselson and Stahl involves:

- mixing the DNA sample with concentrated sugar solution
- placing the mixture of DNA and sugar solution in test-tubes
- spinning the test-tubes at a very high speed.

Suggest **three** precautions that Meselson and Stahl would have taken in order to ensure that the centrifugation part of their investigation produced valid results.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

[Total: 17]

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6 At the beginning of the nineteenth century, one species of squirrel, *Sciurus vulgaris*, the red squirrel, inhabited Great Britain.

In 1879, some individuals of *Sciurus carolinensis*, the grey squirrel, were introduced to southern England from the USA. Since then, the number and range of grey squirrels have increased and the number and range of red squirrels have decreased dramatically.

Grey squirrels are larger, spend more time on the ground and are less frightened of people than red squirrels.

(a) Northumberland is one of the few areas of England that still has a large population of red squirrels.

In an attempt to preserve the population of red squirrels, and the biodiversity of the UK, the government has funded a cull (trapping and killing) of grey squirrels in Northumberland.

(i) Define the term *biodiversity*.

.....

.....

.....

..... **[2]**

(ii) Suggest **two** specific reasons why the government feels it is important to conserve red squirrels in a particular area, such as Northumberland.

1 .....

.....

.....

2 .....

.....

.....

[2]

(iii) Some local residents have objected to the culling of grey squirrels.

Give **one** reason why people might disagree with the culling of grey squirrels.

.....

.....

..... **[1]**

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(b) Environmental groups have asked members of the public to report sightings of grey and red squirrels. In parts of Northumberland, the **reported number of sightings** of grey squirrels is higher than that of red squirrels.

Suggest **two** reasons why the **actual number** of grey squirrels might **not** be higher than the actual number of red squirrels in these areas.

1 .....

.....

.....

2 .....

.....

.....

[2]

(c) In 2010, a company applied for permission to build a wind farm in rural Northumberland. Before permission was granted for the development, an Environmental Impact Assessment (EIA) was carried out by the local authority.

State **three** criteria that would have been considered when the EIA was carried out.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

[Total: 10]

Question 7 begins on page 18

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7 In the first half of the nineteenth century, a large proportion of the population of Ireland relied on potatoes as their main source of food.

In 1845, almost the whole of the Irish potato crop became infected with a disease known as potato blight, which ruined the crop and led to widespread starvation.

Some varieties of potato plants, including wild types growing in South America, are unaffected by the disease.

(a) Genetic variation in the Irish potato plant population was very low following years of selective breeding and asexual reproduction.

(i) Suggest why this lack of genetic variation might have contributed to the rapid spread of the disease.

.....

.....

..... **[1]**

(ii) Suggest why, despite the low genetic variation, the average yield of potato plants varied from year to year.

.....

.....

.....

.....

..... **[2]**

(iii) Some potato plants carry a gene that gives the plants resistance to potato blight.

State the most likely cause of this genetic variation.

..... **[1]**

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(b) Describe how it is possible to use selective breeding to improve the overall disease resistance of a crop, such as potatoes, in both the short and long term.

In your answer you should include precautions that should be taken to ensure disease susceptibility does not become a problem in the future.

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.... **[7]**

[Total: 11]

Question 8 begins on page 20

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8 Fig. 8.1, **on the insert**, shows an electron micrograph of an invertebrate known as a 'water bear'.

(a) Complete the following passage about the classification of water bears using the most appropriate terms.

The water bear, *Echiniscus trisetosus* is a member of the genus ..... and the family *Echiniscidae*. This family belongs to the ..... *Echiniscoidea*, which forms part of the class *Heterotardigrada*. Water bears, also known as tardigrades, are classified into a ..... of their own called the *Tardigrada*. Tardigrades form part of the kingdom ..... within the domain ..... . **[5]**

(b) State the meaning of the term *phylogeny* **and** explain how phylogeny is related to classification.

.....

.....

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.....

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.....

..... **[3]**

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(c) Water bears are extremely common in many habitats, including household gardens. However, they were not discovered until approximately 300 years ago.

Suggest reasons why they were not known before this time.

.....

.....

.....

.....

..... **[2]**

[Total: 10]

END OF QUESTION PAPER

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ADDITIONAL ANSWER SPACE

If additional answer space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margins.

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ADDITIONAL ANSWER SPACE

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ADDITIONAL ANSWER SPACE

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GCE

Biology

Advanced Subsidiary GCE

Unit **F212:** Molecules, Biodiversity, Food and Health

Mark Scheme for June 2013

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Annotations

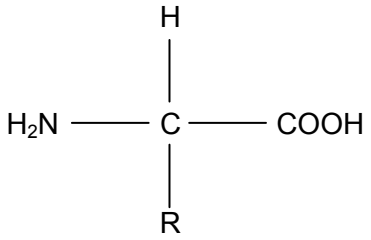
Annotation	Meaning
	Correct answer
	Incorrect response
	Benefit of Doubt
	Not Benefit of Doubt
	Error Carried Forward
	Given mark
	Underline (for ambiguous/contradictory wording)
	Omission mark
	Ignore
	Correct response (for a QWC question)
	QWC* mark awarded
CON	a correct response is associated with a piece of clearly incorrect science within the same statement and award no mark

**Quality of Written Communication*

Subject-specific Marking Instructions

- For questions in which the command word is 'suggest' ignore incorrect responses and credit a correct response wherever it occurs
- Accept phonetic spellings unless otherwise indicated
- All marks are stand-alone unless otherwise stated in Additional Guidance
- For 'idea of' marking points a wide range of wording is acceptable. The mark is to be awarded for the idea.

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Question			Answer	Marks	Guidance
1	(a)	(i)	primary structure ;	1	**ACCEPT** 1° structure **IGNORE** polypeptide
1	(a)	(ii)	NH_2 at one end ; COOH at opposite end ; C in centre (of a single amino acid) bonded (separately) to one R and one H ;	3	If R group not shown as '**R**' then award **max 2** (as general structure asked for in Q) **IGNORE** labels **ACCEPT** displayed structure of NH_2 / HNH **ACCEPT** displayed structure of COOH if correct double bond shown **AWARD** only if the candidate has drawn a single 'amino acid' molecule 
1	(b)	(i)	strength / toughness / insolubility ;	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **ACCEPT** strong / tough **IGNORE** flexible / inelastic **IGNORE** withstand pressure

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Question			Answer		Marks	Guidance
1	(b)	(ii)			6	One molecule of collagen is 3 polypeptide chains twisted around each other. **CREDIT** annotated diagrams unless contradicted by text
			1	peptide bonds , between amino acids / in polypeptide **;**		
			2	every 3rd amino acids is , same / glycine **;**		**2 ACCEPT** high proportion of / 35% , glycine / same amino acid
			3	coil / twist / spiral / helix **;**		**3 CREDIT** in context of single polypeptide or 3 polypeptides **but DO NOT CREDIT 'α**-helix' in the context of a single polypeptide **3 IGNORE** wound
			4	left-handed (helix) **;**		**4 'α**-helix, which is left handed' – **AWARD** mp4 but **DO NOT CREDIT** mp3
			5	glycine / small R group **,** allows closeness / twisting (of polypeptide chains) **;**		
			6	three polypeptide chains **;**		
			7	hydrogen / H , bonds between (polypeptide) chains **;**		**7** Must be in correct context **7 DO NOT CREDIT** H^+ / H_2 bonds
			8	no / few, hydrophilic (R) groups on outside (of molecule) **;**		
			9	(adjacent molecules joined by) crosslinks **;**		**9 ACCEPT** covalent bonds between adjacent molecules **9 DO NOT CREDIT** in context of bonding between 3 polypeptides **9 IGNORE** disulfide
			10	crosslinks / ends of molecules , being staggered **;**		
			11	fibril **;**		**11 IGNORE** micro

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Question			Answer		Marks	Guidance
1	(c)	(i)	transport / AW , of, oxygen / O_2 ;		1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **ACCEPT** buffering blood / carrying CO_2 / storing oxygen **IGNORE** binding oxygen **IGNORE** Iron
1	(c)	(ii)		*haemoglobin (has / is):*	3	**IGNORE** prompt lines – mark as prose but max 2 if an incorrect statement about haemoglobin is given **IGNORE** statements about collagen even if incorrect, answers must refer to haemoglobin
			1	globular ;		**1 IGNORE** not fibrous / ball shaped
			2	hydrophobic (R) groups on inside / hydrophilic (R) groups on outside ;		
			3	4 , chains / sub-units / polypeptides ;		**3 IGNORE** strands / molecules / proteins **4 ACCEPT** in haemoglobin the subunits are not all the same
			4	*idea that* subunits are (two) different types ;		**3&4** "two alpha and two beta chains" = 2 marks (mp 3 and 4)
			5	α / alpha , helix ;		**5 ACCEPT** a-helix
			6	*idea that* proportion of glycine similar to that , of other amino acids / in other proteins ;		**6 ACCEPT** wide(r) range of amino acids **IGNORE** refs to Fe (as part of prosthetic group)
				Total	**15**	

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Question			Answer		Marks	Guidance
2	(a)		enzymes **;**		1	**IGNORE** protein / catalysts **ACCEPT** enzymic
2	(b)	(i)	**1**	similar, shape / structure **;**	3	**1 IGNORE** same shape **1 ACCEPT** 'ethanol same shape as part of DEG'
			2	example of similarity **;**		**2 IGNORE** they contain C, H and O **2 IGNORE** the end is the same **2 ACCEPT** e.g. they both have OH **2 ACCEPT** similar parts identified on diagram if they are clearly indicating an example of similarity
			3	both , will fit into / complementary (shape) to / bind to / bond to , <u>active site</u> (of alcohol dehydrogenase) **;**		**3 ACCEPT** implication of both **3 IGNORE** attach / enter **3 IGNORE** both will form ESC (with alcohol dehydrogenase)
2	(b)	(ii)	**1**	(ethanol) <u>compete</u>s with DEG **; ora**	3	**1 ACCEPT** ethanol / DEG , is , a <u>competitive</u> inhibitor
			2	(when at high(er) concentration) ethanol more likely to , collide with / bind to / bond to , active site **; ora**		**2 ACCEPT** 'ethanol more likely to form ESC' **2 ACCEPT** implication of 'more likely' from context **2 IGNORE** attach / enter
			3	less , DEG breakdown / toxic product **; ora**		**3 ACCEPT** DEG product is diluted **3 ACCEPT** no DEG breakdown **IGNORE** 'you will drink less of it'
				Total	**7**	

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Question			Answer		Marks	Guidance
3	(a)	(i)	**B** and **C** ;		1	Both need to be given for the mark to be awarded. **DO NOT CREDIT** if **A** also given.
3	(a)	(ii)	(involved) after , pathogen / AW , has entered the body ;		1	**IGNORE** ref to primary defence without the clear idea that the pathogen has entered the body **IGNORE** refs to mechanisms of action, e.g. 'phagocytes do not make antibodies' **ACCEPT** attacking foreign bodies after they have passed through the skin
3	(a)	(iii)	(phagocytes) able to, digest / break down / engulf / target / deal with, a range of / many different , pathogens ; **ora**		1	**ACCEPT** bacteria or virus as synonym for pathogen if the idea of a variety is clearly present **ACCEPT** phagocytes can break down *any* pathogen **ACCEPT** phagocytes do not have (antigen-)specific receptors **IGNORE** phagocytes do not make memory cells **IGNORE** antigen if used as synonym for pathogen
3	(a)	(iv)	**1**	lobed / narrow , nucleus ;	2	
			2	(cells) can change shape ;		**2 ACCEPT** in context of cell or nucleus **2 ACCEPT** cells , are plastic / have flexible structure / have flexible membrane **2 IGNORE** squashable / stretch
			3	can squeeze / move / fit / AW , between cells / through pores , in (walls of) capillaries ;		**3 ACCEPT** holes / gaps / fenestrations
			4	histamine makes , capillary walls / endothelium , leaky ;		

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Question			Answer		Marks	Guidance
3	(a)	(v)			6	**ACCEPT** phonetic spellings throughout
			1	(pathogen) engulfed / enveloped / surrounded by cytoplasm (from phagocyte) **;**		**1 ACCEPT** 'pseudopodia / cytoplasm / cell membrane , extend from phagocyte' **1 DO NOT CREDIT** eaten. **ACCEPT** ingested
			2	endocytosis / phagocytosis **;**		
			3	(formation of) phagosome / phagocytic vacuole / phagocytic vesicle **;**		**3 CREDIT** in correct context only
			4	(phago) lysosomes **;**		
			5	(lysosomes / phagosome) move towards / fuse with (each other) **;**		**5 ACCEPT** attracted to / joins
			6	(named) enzyme(s) / lysins / hydrogen peroxide / free radicals (in lysosomes) **;**		
			7	(pathogen) digested / broken down / hydrolysed **;**		**7 IGNORE** destroyed / broken up / killed
			8	(to) amino acid / sugar / glucose / fatty acid / glycerol **;**		
			9	(break down products) absorbed / AW (into cytoplasm) **or** unwanted products removed (by exocytosis) **;**		**9 IGNORE** refs to antigen presentation **9 ACCEPT** enter cytoplasm
			10	cytoskeleton involved in (endocytosis / movement of vesicles) **;**		
			QWC key points in sequence **;**		1	**Award** if the following mark points have been awarded: **mp 1 or 2** followed by **mp 6 or 7**

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Question			Answer	Marks	Guidance
3	(b)	(i)	*Mycobacterium* /*M. tuberculosis* / *M. bovis* ;	1	**ACCEPT** phonetic spellings **IGNORE** case of initial letter No need to underline
3	(b)	(ii)	droplets (containing pathogen) ; (released by) coughing / sneezing ; inhaled by (uninfected) , individual / AW ;	2	**IGNORE** airborne **IGNORE** laughing / talking / kissing / breathed out

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Question			Answer		Marks	Guidance
3	(c)	(i)			3	**Mark points 1-5 cannot be inferred from figures**
			1	in both years incidence (of TB) , decreases / AW , as income , increases / AW **; ora**		**1 ACCEPT** 'incidence is higher in low income group and lower in high income group, in both years / always'
			2	no change in, low / lower middle, (income groups) **;**		
			3	increase in upper middle (income group) **;**		**3 ACCEPT** upper middle less in 2000
			4	decrease in high (income group) **;**		**4 ACCEPT** high (group) more in 2000
			5	*idea of* overall very little change between 2000 and 2008 **;**		
			6	calculated difference in figures with units to support points 3 to 5 **;**		**6 ACCEPT** any increase or decrease e.g., high group has gone down by 3 per 100000 **6 ACCEPT** also • 10% increase in upper middle group • 17.6% / 18% , decrease in high income group • 1% / 1.3% , increase overall • high income group in 2008 is , 82.4% / 82% / 0.824 / 0.82 , of original value **6 IGNORE** 0% increase in low / lower middle income groups There is no need to refer to years as only 2 are shown

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Question			Answer		Marks	Guidance
3	(c)	(ii)			3	**IGNORE** prompt lines and mark as prose
			1	overcrowded / AW (living space) **;**		**1 ACCEPT** cramped
			2	poorly ventilated (living space) **;**		
			3	poor diet / malnourished **;**		
			4	poor health **;**		**4 ACCEPT** poor immune system **4 IGNORE** hygiene / standard of living
			5	homelessness **;**		
			6	*idea that* more likely to consume , meat / milk, from infected cattle **;**		
			7	*idea of* vaccination / medical treatment , more difficult to access **;**		**7 CREDIT** healthcare more expensive **7 ACCEPT** poor healthcare **7 IGNORE** less aware of the risks
				Total	**21**	

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<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>4</td><td>(a)</td><td>(i)</td><td>
<table>
<tr><th>species</th><th>number of individuals (n)</th><th>n/N</th><th>$(n/N)^2$</th></tr>
<tr><td>Dog's mercury</td><td>40</td><td>0.40</td><td>0.1600</td></tr>
<tr><td>Wild strawberry</td><td>13</td><td>0.13</td><td>0.0169</td></tr>
<tr><td>Common avens</td><td>43</td><td>0.43</td><td>0.1849</td></tr>
<tr><td>Wood sorrel</td><td>4</td><td>0.04</td><td>0.0016</td></tr>
<tr><td></td><td>N = 100</td><td></td><td>$\Sigma(n/N)^2$ = 0.3634</td></tr>
<tr><td></td><td></td><td></td><td>$1-(\Sigma(n/N)^2)$ = 0.6366</td></tr>
</table>
; ; ;</td><td>3</td><td>Award 3 marks for the correct answer (0.6366)

If answer is incorrect:

IGNORE numbers in first 4 rows

'N = 100' = 1 mark

$\Sigma(n/N)^2$
ALLOW ecf for correct calculation from candidate's incorrect N value

$1-(\Sigma(n/N)^2)$
ALLOW ecf for correct calculation from candidate's $\Sigma(n/N)^2$ value

Answer must be given to 4 dp for ecf</td></tr>
<tr><td>4</td><td>(a)</td><td>(ii)</td><td>species richness
number of species (in an area / habitat) ;

species evenness
number of / how many, individuals there are of, each / every, species (in an area / habitat) ;</td><td>2</td><td>IGNORE organisms / abundance / quantity / variety
DO NOT CREDIT amount

ACCEPT 'organisms' as AW for individuals
CREDIT relative abundance of (each) species / population size of each species
IGNORE relative abundance of, a / one, species
DO NOT CREDIT amount</td></tr>
</table>

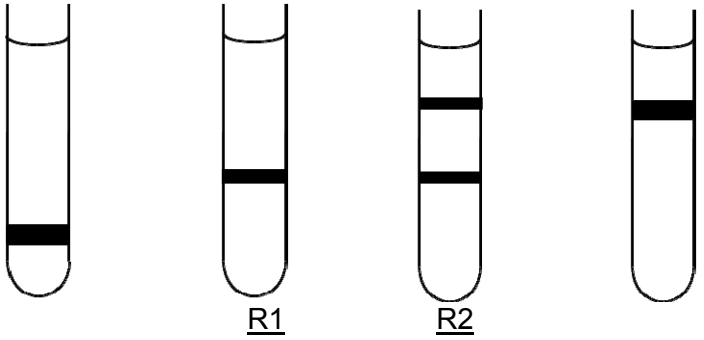
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Question			Answer	Marks	Guidance
4	(a)	(iii)	(habitat) dominated by, one / few / AW, species **;** change in one species , likely to affect whole habitat / AW **;** community / ecosystem / habitat / area , is unstable / not able to withstand change / easily damaged **;**	2	**ACCEPT** high number of one species **IGNORE** environment / biodiversity as AW for community **IGNORE** the community / AW will be damaged
4	(b)		**1** *idea of* random sampling **;** **2** standardisation of technique **;** **3** use of, key/identification chart **;** **4** survey at different , times of year / season **;** **5** include , trees / species larger than quadrat **;**	2	**IGNORE** prompt lines and mark as prose **1 ACCEPT** description of randomisation method **2 ACCEPT** description of standardisation method **2 ACCEPT** count the same way each time **4 IGNORE** 'repeat' unqualified **4 IGNORE** different times of day / different times
			Total	**9**	

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Question			Answer	Marks	Guidance
5	(a)	(i)	**X** cytosine / pyrimidine **;** **Y** nucleotide **;**	2	**Mark the first answer on each prompt line.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **X ACCEPT** nitrogenous base / organic base **X IGNORE** C
5	(a)	(ii)	at least one line between all opposite bases **;** two lines between A and T **and** three lines between both instances of C and G **;**	2	**IGNORE** bond labels / H / O / δ^+ / δ^- Bases on left strand do not need to be labelled but **CON** this mark if incorrectly labelled
5	(a)	(iii)	polypeptide **;** ribosome **;**	2	**ACCEPT** protein
5	(a)	(iv)	(usually) single stranded / would not have 2 strands **;** uracil / U, instead of thymine / T **;**	2	**Mark the first answer on each prompt line.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **IGNORE** shorter **ACCEPT** only one backbone **DO NOT CREDIT** incorrect spelling of thymine with 'a' **IGNORE** difference in sugar as on the diagram ribose and deoxyribose would appear the same
5	(b)	(i)	one strand, from original DNA **and** one strand newly formed **;** an , (original) strand / polynucleotide , acts as template (for new strand) **;**	2	**ACCEPT** one old and one new strand **ACCEPT** each strand is copied

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Question			Answer	Marks	Guidance
5	(b)	(ii)	(DNA) can be replicated without error **/** same sequence of nucleotides is produced **;** reduces occurrence of mutation **;** allows (re-)formation of , hydrogen / H , bonds **;**	2	**ACCEPT** formation of identical DNA **ACCEPT** same / correct , order / sequence , of bases This mark point is for the correct use of the term 'mutation' and does not imply without error. **ACCEPT** prevents mutation **DO NOT CREDIT** H^+ / H_2 bonds
5	(c)	(i)	horizontal band drawn in tube R1 clearly higher than band in ^{15}N tube and clearly lower than band in ^{14}N tube **;**	1	**DO NOT CREDIT** if more than one band drawn **IGNORE** thickness of bands and whether bands are shaded **DO NOT CREDIT** if there is any overlap with a band in another tube  **DO NOT CREDIT** if more than two bands drawn **IGNORE** thickness of bands and whether bands are shaded
5	(c)	(ii)	one band (in R2) clearly at the same height as that in tube R1 **and** one band (in R2) clearly at the same height as that in the ^{14}N tube **;**	1	

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Question			Answer	Marks	Guidance
5	(d)			3	**IGNORE** prompt lines - mark as prose I**GNORE** amount throughout
			same concentration of sugar (solution in each tube) **;** same volume of, mixture / solution / sugar solution (in each tube) **;**		**IGNORE** mass **IGNORE** mass **IGNORE** volume , of sugar / DNA extract
			spin (all tubes) at same , speed / acceleration **;** spin (all tubes) for same (length of) time **;**		**ACCEPT** tubes spun at constant speed **IGNORE** temperature / pH **IGNORE** mass of DNA
			Total	**17**	

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Question			Answer		Marks	Guidance
6	(a)	(i)	range / variety / number **,** of species (in an area) **;** range / variety of, habitats / ecosystems **;** variety of , alleles / genes **;**		2	**IGNORE** amount throughout **ACCEPT** a combination of species richness and species evenness **ACCEPT** abundance **IGNORE** organisms **ACCEPT** number of habitats
6	(a)	(ii)	**1**	part of (local) food , chain / web **;**	2	**IGNORE** prompt lines and any reference to biodiversity **CREDIT** a correct response anywhere in the answer **IGNORE** unspecified refs to ethical, aesthetic or economic **1 ACCEPT** keystone species
			2	tourism **;**		
			3	native species / *idea of* heritage of the area **;**		**3 ACCEPT** native to UK
			4	to protect a neighbouring red squirrel population **;**		
			5	*idea that* Northumberland red squirrel population is nationally significant **;**		**5** e.g. Northumberland has significant proportion of total population so loss of this population might jeopardise all British squirrels **IGNORE** refs to genetic resource as no suggestion that this population is distinct from red squirrels elsewhere.

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Question			Answer		Marks	Guidance
6	(a)	(iii)	*idea that:* it is wrong to interfere with nature **;** it is wrong to kill animals **;** grey has (as much) right to live there (as red) **;** *idea that* might be useful in the future / enjoyed by future generations **;** grey will be part of food chain **;**		1	**ACCEPT** qualified refs to , moral / ethical / religious , reasons **IGNORE** it's wrong to play God **ACCEPT** it is cruel
6	(b)			*idea that*: **1** harder to see **; ora** **2** (harder to see because) more timid / frightened of people / spend less time on ground / smaller **; ora** **3** species may be wrongly identified **;** **4** grey squirrels more likely to visit gardens / parks / public areas **; ora** **5** people are more inclined to report grey sightings **; ora** **6** AVP **: ora**	2	**IGNORE** prompt lines and mark as prose **CREDIT** correct response where seen **1 ACCEPT** 'they remain hidden'. **IGNORE** 'they may be hiding' **2 IGNORE** 'they may be hiding' **6 ACCEPT** grey squirrels might be less camouflaged (so easier to see) **6 ACCEPT** red squirrels might be (more) nocturnal / AW **6 IGNORE** squirrel species hard to distinguish / same individual counted more than once

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Question			Answer		Marks	Guidance
6	(c)				3	**IGNORE** prompt lines and mark as prose **IGNORE** refs to benefits of development Answers should be given in terms of assessing aspects of the development.
			1	size (of development) **;**		**1 ACCEPT** 'how big will it be?'
			2	*idea of* environmental sensitivity / which species present / which habitats present , in the area **;**		**2 ACCEPT** e.g. 'what lives there?' / 'whether a rare species live there' 'whether red squirrels live there' / 'the biodiversity of the area' / is it an SSSI? / species richness
			3	potential damage (to area / organisms) **;**		**3 ACCEPT** e.g. 'how much damage will it do?' / effect on ecosystem / how much it would be destroyed / how many organisms will it kill?
			4	*idea of* potential strategies to minimise impact **;**		**4 ACCEPT** e.g. 'what can be done about it?' / possible change to reduce impact **4** Must be a general statement **4 IGNORE** stated example without the general idea
				Total	**10**	

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Question			Answer		Marks	Guidance
7	(a)	(i)	*idea of* if one susceptible to, this / the disease, all likely to be **;**		1	**DO NOT CREDIT** if the response is referring to diseases in general
7	(a)	(ii)	**1**	environment / environmental factor **;**	2	
			2	(variation in) weather conditions / temperature **;**		**2 ACCEPT** climate
			3	rainfall / soil water content **;**		**3 IGNORE** 'availability of water' unqualified
			4	soil , (named) mineral / nitrate , content / AW **;**		**4 IGNORE** nutrient **4 ACCEPT** mineral availability / amount of fertiliser added
			5	(named) biotic factor (might vary) **;**		**5** e.g. number of pests / competition from other plants / disease
7	(a)	(iii)	mutation **;**		1	**ACCEPT** deletion etc. **IGNORE** (named) mutagenic agent

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Question			Answer		Marks	Guidance
7	(b)				6	If a candidate describes resistance as immunity **DO NOT CREDIT** the first time it is seen but apply **ECF** thereafter
			1	cross / breed, with disease resistant variety **;**		**1 ACCEPT** make two disease resistant individuals reproduce **1 IGNORE** crossbreed two best individuals
			2	method to test offspring for disease resistance **;**		**2 ACCEPT** general statement **or** example e.g: 'germinate seeds, expose to disease, see if die'
			3	select , best offspring / offspring with resistance **;**		**3 ACCEPT** seeds / tubers / potatoes **3 IGNORE** children / babies
			4	(inter)breed, offspring with resistance / best offspring **;**		
			5	(continue process) for (many) generations **;**		**5 IGNORE** many years
			6	*idea of* avoid breeding**,** closely related / AW , individuals to preserve genetic diversity **; ora**		**6 ACCEPT** avoid , inbreeding / inline breeding **6 ACCEPT** 'maintain genetic diversity by breeding with plants from different field / area' **6 ACCEPT** breed with different varieties to widen the gene pool
			7	(regularly back) cross with, wild variety **;**		
			8	*idea of* preserving rare varieties in case they are needed in the future **;**		**8 ACCEPT** use of seed bank to preserve range of alleles
			9	AVP **;**		**9** e.g, ref. to marker assisted selection / detail of pollination method / prevention of self-pollination / asexual reproduction of desired variety
			QWC ;		1	**Award** if the answer has been given **one** mark from marking points **1–5 and one** mark from marking points **6–8**
				Total	**11**	

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Question			Answer		Marks	Guidance
8	(a)				5	**Mark the first answer on each prompt line.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **ACCEPT** phonetic spellings
			1	*Echiniscus* ;		**1** Initial letter must be upper case
			2	order ;		**2 ACCEPT** super family / epifamily
			3	phylum ;		
			4	Animalia ;		**4 ACCEPT** animals **4 IGNORE** case of initial letter
			5	Eukaryota ;		**5 ACCEPT** eukaryotes / Eukarya / eukaryotic **5 IGNORE** case of initial letter
8	(b)		**1**	(phylogeny is) evolutionary relationships (between organisms) ;	3	**1 IGNORE** 'evolution' without further qualification **1&2** phylogeny is the closeness of evolutionary relationships = 2 **marks** **1 ACCEPT** phylogeny is evolutionary history
			2	(phylogeny is study of) closeness of (evolutionary) relationships ;		
			3	phylogeny is basis of / used in , natural / scientific / modern, classification ;		**3 ACCEPT** new **3 IGNORE** related to classification
			4	*idea that* the closer the (evolutionary or genetic) relationship the closer the (taxonomic) grouping ;		**4 ACCEPT** ref to **recent** common ancestors as AW for close relationship **4 ACCEPT** named taxonomic group for 'grouping' **4 ACCEPT** 'if the DNA is very different then the group is not the same'
			5	correct use of example ;		**5** e.g. gorillas and chimpanzees (closely grouped)

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Question			Answer	Marks	Guidance
8	(c)		too small to see **;** (unable to see them) until invention of microscope / development of suitable viewing apparatus / AW **;** only 0.3mm in length **;**	2	'can only be seen under microscope' **= 1 mark (mp1)** **IGNORE** 'can't see it' without the idea of size, e.g. can't see it clearly = **0 marks**, can't see its features = **0 marks** **ACCEPT** implication of being too small to see, e.g. 'you need a microscope to see them' **= mp1** 'people couldn't see them in the past because we didn't have microscopes' **= 2marks (mp1 and mp2)** **IGNORE** type of microscope if stated **ACCEPT '**magnifying glass' **ACCEPT** ± 0.1 mm
			Total	**10**	

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Mark Scheme Conventions

The following conventions appear in the Mark Scheme

1. Bracketed words. The words in brackets are there to 'set the scene' and indicate the context in which the answer is expected. They do not need to appear. Award the mark as long as the statement in the brackets is not contradicted.

2. Solidus /. A solidus indicates alternative ways that a mark might be gained for a given Mark Point.

3. Use of the comma in a mark point. This indicates that some information from either side of the comma or commas is needed. It is used in conjunction with the solidus.

   In some cases the Guidance column may indicate examples of wording or terms that are acceptable (ACCEPT) or that should be ignored (IGNORE). In the case of IGNORE read on to see if something creditworthy appears later in the response.

4. Underlining.

   - solid underline. The word or part of word underlined is required but minor mis-spellings are acceptable as long as the word is phonetically the same
   - wavy underline. This indicates that whilst the word underlined is not precisely needed, alternative responses need to be closely related in meaning or be a clear description.

5. *idea of.* This is used as a prefix to marking points where there may be a fairly wide range of responses which cover the essence of the required response. This often requires examiner judgement. These often, but not exclusively, appear in questions such as those related to environmental or health issues.

6. ORA: 'or reverse argument' In cases where candidates could be credited for having described a process from the opposite point of view, ora is sometimes used on a mark scheme to save space. For example, in question 6(b) the question could be answered from the point of view of why red squirrels are hard to see or why grey squirrels are easy to see.

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RECOGNISING ACHIEVEMENT

Tuesday 15 January 2013 – Afternoon

AS GCE BIOLOGY

F212/01 Molecules, Biodiversity, Food and Health

F2120301

Candidates answer on the Question Paper.

OCR supplied materials:
None

Other materials required:
- Electronic calculator
- Ruler (cm/mm)

Duration: 1 hour 45 minutes

F 2 1 2 0 1

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined pages at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **100**.
- Where you see this icon you will be awarded marks for the quality of written communication in your answer.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.
- This document consists of **24** pages. Any blank pages are indicated.

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Answer **all** the questions.

1 Many insects live in freshwater habitats such as rivers and ponds for part of their life cycle.

Fig. 1.1 shows a labelled diagram of a generalised insect along with six common insects found in freshwater in the UK.

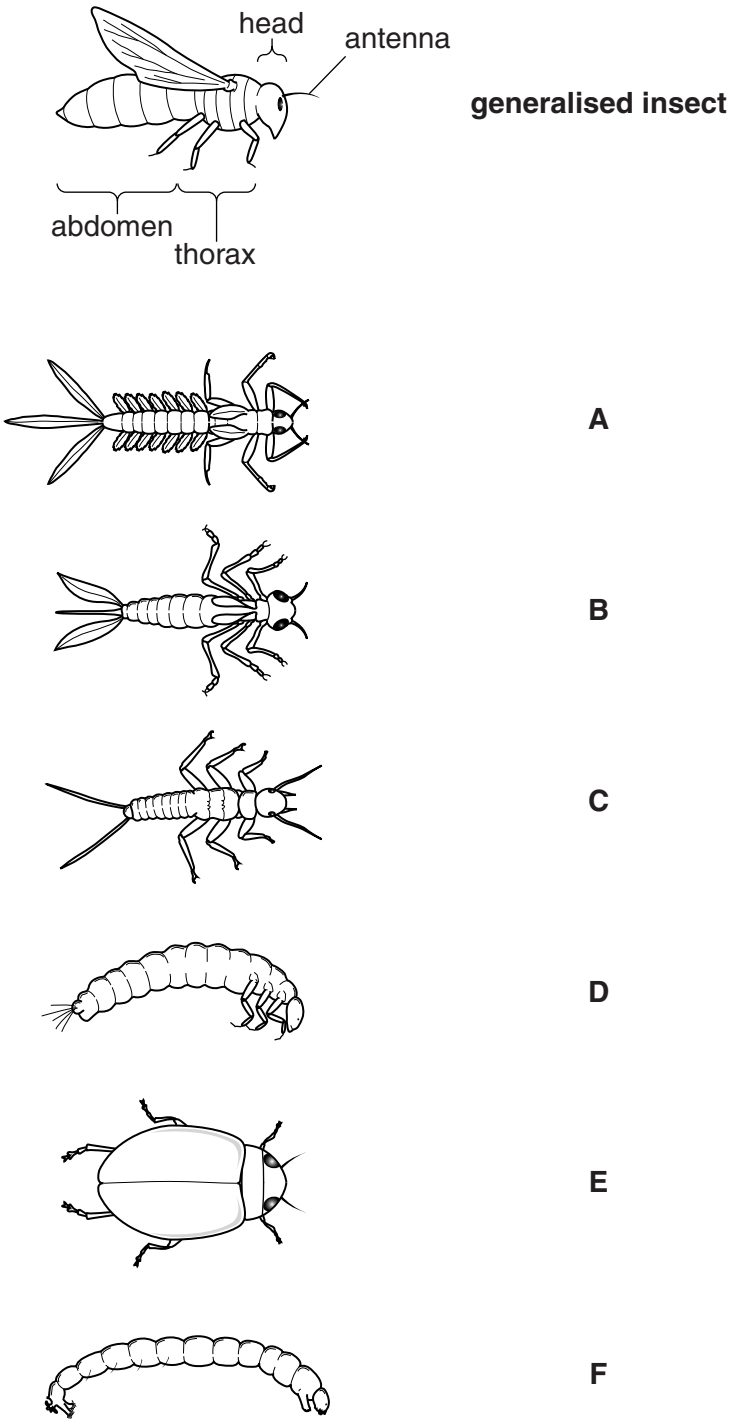


Fig. 1.1

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Table 1.1 below shows a dichotomous key used for the classification of insects.

Key:			
Question 1	Does it have jointed limbs?	yes no	go to question 2 **bloodworm**
Question 2	Does it have an oval body shape?	yes no	**diving beetle** go to question 3
Question 3	Is the length of the tail greater than the length of three abdominal segments?	yes no	go to question 4 **caddis fly larva**
Question 4	Are gills attached to the abdominal segments?	yes no	**mayfly larva** go to question 5
Question 5	Does it have two narrow tails?	yes no	**stonefly larva** **damsel fly larva**

Table 1.1

(a) (i) Use Table 1.1 to identify the insects labelled **A** to **F** shown in Fig. 1.1.

A .....

B .....

C .....

D .....

E .....

F .....

[2]

(ii) Why is the key in Table 1.1 described as a *dichotomous* key?

.....

..... **[1]**

(b) Suggest an adaptation shown by at least one of the insects in Fig. 1.1 that allows them to survive in an aquatic habitat.

.....

..... **[1]**

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(c) Insects belong to the animal kingdom within the domain *Eukaryota*.

(i) Suggest **one** feature of the cells of insects that would identify insects as belonging to the domain *Eukaryota*.

.....

..... **[1]**

(ii) State **two** features that are present in the eukaryotic cells of plants that are **absent** from the cells of insects.

1 .....

2 .....

[2]

[Total: 7]

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Question 2 begins on page 6

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2 **(a)** In the UK in 2009, there was a major outbreak of a type of influenza known as 'swine flu'.

'Swine flu' was caused by a new strain of the influenza virus.

Explain why the influenza virus is usually described as a *pathogen* rather than a *parasite*.

.....

.....

.....

.....

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.....

.....

..... **[3]**

(b) When an individual is infected with a virus, an immune response is triggered.

(i) Define the term *immune response*.

.....

.....

.....

..... **[2]**

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(ii) One type of cell involved in an immune response is a plasma cell, which releases antibodies.

Plasma cells contain RNA.

Outline the roles of RNA in plasma cells.

In your answer you should give an account of the different roles of RNA.

[6]

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(iii) Outline **two** ways in which antibodies reduce the threat from pathogens.

.....

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.....

..... **[4]**

(c) (i) In an attempt to reduce the consequences of further outbreaks of influenza, the government encourages immunisation of key groups of people, such as the elderly and children that have another risk factor.

Suggest **two other** groups who should be immunised **and** explain why immunisation for them would be particularly important.

1 .....

.....

.....

.....

2 .....

.....

.....

.....

[4]

(ii) Immunisation of large numbers of people costs the UK government a lot of money.

Other than the direct effects on health or reducing the number of deaths, suggest a reason why spending a large amount of money on immunisation is considered worthwhile.

.....

.....

..... **[1]**

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(iii) Much of the money spent on immunisation programmes is used to publicise the health benefits of immunisation. Despite this, some individuals are reluctant to have the immunisation.

Give **one** reason why, despite being aware of the immunisation programme, some people choose not to be immunised.

.....

.....

..... **[1]**

[Total: 21]

Question 3 begins on page 10

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3 **(a)** Complete the passage below using the most appropriate terms.

Enzymes are ..... proteins and are therefore soluble. They alter the rate of metabolic reactions and are described as biological ..... .

Some enzymes, such as those found in cytoplasm, are described as ..... enzymes. Other enzymes, such as those that digest food in the small intestine, are known as ..... enzymes. Some medicinal drugs reduce enzyme activity. These are called enzyme ..... . **[5]**

(b) Many enzymes are associated with non-protein molecules known as cofactors. Some cofactors are small inorganic ions.

Rennin is an enzyme that is involved in the digestion of milk. It converts soluble caseinogen in milk into insoluble casein. The cofactor Ca^{2+} is associated with this reaction.

A student wished to investigate the effect of Ca^{2+} on the action of rennin.

Describe how the student could carry out this investigation and produce valid results.

.....

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..... **[5]**

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(c) Enzyme cofactors are often derived from vitamins and minerals in the diet.

Proteins are required in large amounts in the diet whereas vitamins and minerals are required only in small amounts.

Suggest why.

.....

.....

..... **[1]**

[Total: 11]

Question 4 begins on page 12

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4 **(a)** Lipids form an important part of a balanced diet but if too many lipids are consumed this can result in obesity.

What is meant by the term *balanced diet*?

.....

.....

.....

..... **[2]**

(b) **(i)** Lipids are used for energy storage and as a respiratory substrate.

List **three** other roles of lipids in the human body.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

(ii) Other than obesity, outline why a diet high in lipids might have a negative effect on the health of an individual.

.....

.....

.....

.....

.....

.....

..... **[3]**

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(c) Two examples of lipid molecules are triglycerides and phospholipids.

Identify **two** differences and **two** similarities in the **structures** of triglycerides and phospholipids.

Write your answers in the appropriate boxes in the table below.

	Triglyceride	**Phospholipid**
Difference		
Difference		
Similarity		
Similarity		

[4]

(d) It is possible to test for the presence of lipids in a food sample.

(i) Name the test used to identify the presence of lipids.

..... **[1]**

(ii) Describe how you would carry out this test on a food sample.

.....

.....

.....

.....

.....

.....

..... **[3]**

(iii) State the expected result if lipid is present in the food sample.

.....

..... **[1]**

[Total: 17]

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5 Scientists have identified approximately 1.8 million different species. The number of species that actually exist is likely to be significantly higher than 1.8 million.

(a) Suggest **two** reasons why the number of species identified is likely to be lower than the actual number of species present on Earth.

1 .....

.....

2 .....

.....

[2]

(b) Many organisations, such as the International Union for the Conservation of Nature (IUCN), gather annual data about the number of species that are known to exist and to what extent they are considered to be endangered.

Fig. 5.1 shows the total number of species assessed by the IUCN over a 10 year period and the number of those species assessed that are considered to be threatened with extinction.

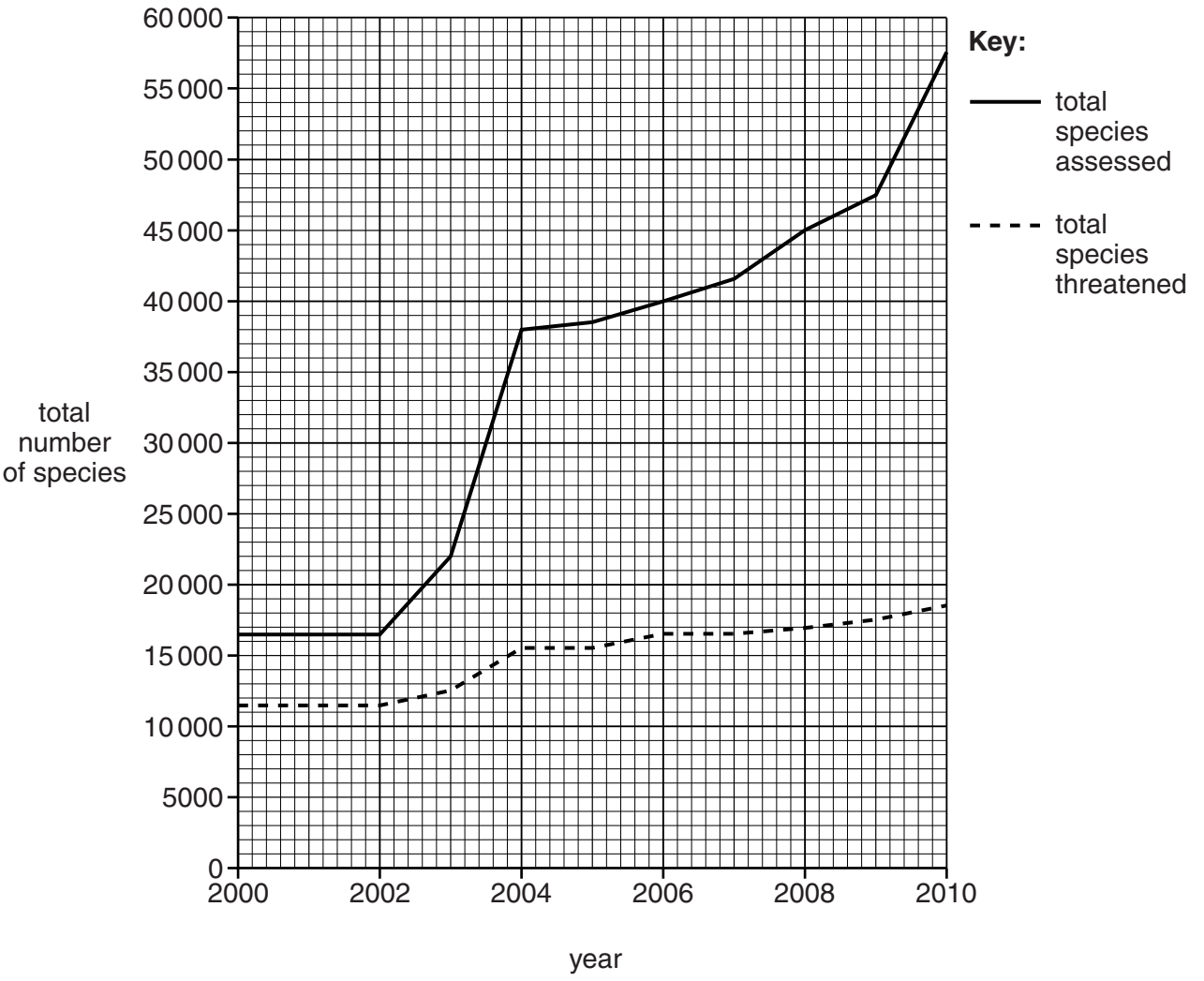


Fig. 5.1

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(i) Using Fig. 5.1, **compare** the changes in the total number of species assessed with the changes in the total number of threatened species over the 10 year period.

.....

.....

.....

.....

.....

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.....

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.....

.....

..... **[3]**

(ii) Using Fig. 5.1, calculate the percentage of species assessed that were threatened with extinction in **2010**.

Show your working. Give your answer to the **nearest whole number**.

Answer = ... % **[2]**

(iii) Suggest explanations for the shape of the two curves between **2005** and **2010**.

.....

.....

.....

.....

.....

..... **[2]**

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(c) A study of the biodiversity of an area considers not only the total number of species but also the relative number of individuals within each species.

State **one** further factor that could be taken into account when describing the biodiversity of an area.

.....

..... **[1]**

(d) In any attempt to protect global biodiversity, cooperation between countries is important.

Two examples of such international cooperation are:

- Convention on International Trade in Endangered Species (CITES)
- Rio Convention on Biological Diversity.

Other than the conservation of biodiversity, state **two** aims for each of these conventions.

Convention on International Trade in Endangered Species .....

.....

.....

.....

.....

.....

Rio Convention on Biological Diversity .....

.....

.....

.....

.....

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[4]

[Total: 14]

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Question 6 begins on page 18

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6 **(a)** Glucose is a hexose sugar and is a monomer in many carbohydrates.

Name the precise group of carbohydrate molecules of which glucose is an example.

..... **[1]**

(b) Fig. 6.1 represents the structure of a **β-glucose** molecule.

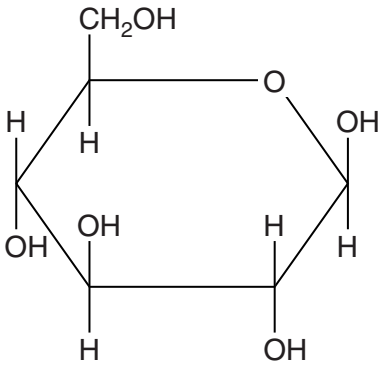


Fig. 6.1

(i) Use Fig. 6.1 to draw a similar representation of an **α-glucose** molecule in the space provided below.

[2]

(ii) The cells of living organisms require glucose.

State and explain **two** ways in which the glucose molecule is well suited to its function in living organisms.

.....

.....

.....

..... **[2]**

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(c) Deoxyribose is a pentose sugar that is a component of the double-stranded DNA molecule.

Describe the structural relationship between deoxyribose and the other components of the DNA molecule.

.....

.....

.....

.....

.....

.....

..... **[3]**

(d) Cellulose is a carbohydrate.

A student described the structure of cellulose as follows:

> The cellulose molecule is insoluble.
> It contains only the elements carbon, hydrogen and oxygen.
> It is made up of α-glucose subunits.
> The glucose subunits are linked by 1-4 glycosidic bonds formed by hydrolysis reactions.
> It also has some 1-6 glycosidic bonds.
> It is made of many long chains.
> The chains have branches.

(i) Identify **three** mistakes made by the student when describing the structure of cellulose.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

(ii) Suggest the name of a molecule that closely matches the student's description.

..... **[1]**

[Total: 12]

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7 **(a)** Humans have been using microorganisms to make food for over 4000 years. Yoghurt is a dairy product that is produced by the action of microorganisms on milk.

Suggest why yoghurt production relies on a plentiful supply of plants.

.....

..... **[1]**

(b) Protein known as mycoprotein is promoted as a healthy alternative to meat. Mycoprotein is made using fungal microorganisms.

Discuss the advantages **and** disadvantages of using microorganisms to produce protein for human consumption.



In your answer you should consider a range of advantages and disadvantages.

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..... **[8]**

(c) Microorganisms can also be responsible for food spoilage. In order to prevent this spoilage, a range of food preservation methods are used.

Complete the table below to explain how the **three** methods of food preservation reduce food spoilage.

Method	Explanation
Freezing	
Pickling	
Irradiation	

[3]

[Total: 12]

Question 8 begins on page 22

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8 The table below shows some biological terms and descriptions that are used in topics on evolution, biodiversity and conservation.

Complete the table using the most appropriate terms or descriptions.

The first one has been done for you.

Biological Term	Description
Natural Selection	The theory proposed by Darwin on the evolution of species.
Speciation	
	Differences between individuals that cover a range of values rather than discrete categories.
Adaptation	
	A system of naming organisms that uses two scientific (Latin) names for species.
	The type of conservation of which seed banks are an example.
	A study carried out by a local planning authority in order to judge the effect of a development on the biodiversity of an area.

[6]

[Total: 6]

END OF QUESTION PAPER

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ADDITIONAL ANSWER SPACE

If additional answer space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margins.

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GCE

Biology

Advanced Subsidiary GCE

Unit **F212:** Molecules, Biodiversity, Food and Health

Mark Scheme for January 2013

Oxford Cambridge and RSA Examinations

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Annotations used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

Annotation	Meaning
	Correct answer
	Incorrect response
	Benefit of Doubt
	Not Benefit of Doubt
	Error Carried Forward
	Given mark
	Underline (for ambiguous/contradictory wording)
	Omission mark
	Ignore
	Correct response (for a QWC question)
	QWC* mark awarded
	Contradiction

**Quality of Written Communication*

Subject-specific Marking Instructions

- Use **CON** when a correct response is associated with a piece of clearly incorrect science within the same statement and award no mark.
- For questions in which the command word is ‘suggest’ ignore incorrect responses and credit a correct response wherever it occurs.
- Accept phonetic spellings unless otherwise indicated.
- All marks are stand-alone unless otherwise stated in Additional Guidance.
- For ‘idea of’ marking points a wide range of wording is acceptable. The mark is to be awarded for the idea.

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Question			Answer	Marks	Guidance
1	(a)	(i)	**A** mayfly (larva) **B** damsel fly (larva) **C** stonefly (larva) **D** caddisfly (larva) **E** diving beetle **F** bloodworm **;;**	2	**Mark the first answer on each prompt line.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks *All 6 correct = 2 marks* *4 (or 5) correct = 1 mark*
1	(a)	(ii)	(each question has) two options / AW **;** each question has yes or no option / AW **;**	1	**ACCEPT** alternating
1	(b)		**1** gills **;** **2** streamlined (shape) / absence of wings **;** **3** flattened shape **;** **4** tail(s) / hind legs , for , propulsion / swimming / moving **;** **5** blood pigment for storing oxygen ;	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks Answers must relate to adaptations for living in an aquatic environment. **4 IGNORE** 'tail(s)' unqualified
1	(c)	(i)	nucleus **;** membrane bound organelles / named organelle **;** 80S / 22nm / large(r) **,** ribosomes **;**	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **IGNORE** lack of named prokaryotic feature **ACCEPT** big(ger) ribosomes

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Question			Answer	Marks	Guidance
1	(c)	(ii)	chloroplast(s) ; large / permanent , vacuole ; tonoplast ; starch (grains) ; AVP ;	2	**Mark the first answer on each prompt line.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **IGNORE** chlorophyll **ACCEPT** cell wall (even though not actually inside a cell)
			Total	**7**	

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Question			Answer	Marks	Guidance
2	(a)		**1** pathogen causes disease / not all parasites cause disease **;** **2** (influenza) virus causes a disease / influenza is a disease **;** **3** parasite gains , nutrition / energy , from host **;** **or** (influenza virus) does not gain , nutrients / energy , from host **;** **4** virus takes over / AW , (host cell) DNA / genetic material **;**	3	**ACCEPT** damage to health / illness , as AW for 'disease' **1 IGNORE** 'parasites do not cause disease' **2 DO NOT CREDIT** 'virus is a disease' / 'influenza causes disease' **2 ACCEPT** '(swine) flu is a disease' **Note:** the influenza virus is a pathogen because it causes disease = 2 marks (mp1 and mp2) **3 ACCEPT** AW for 'gains nutrition from', e.g. 'feeds on' **3 IGNORE** 'lives off host' / 'benefits from host' **3 ACCEPT** idea of 'host' in context of suitable example
2	(b)	(i)	(response) to an antigen **;** involves , lymphocytes / production of antibodies **;**	2	

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Question			Answer	Marks	Guidance
2	(b)	(ii)	**1** antibodies are proteins **;** **2** DNA unable to leave nucleus **;** **3** (m)RNA , copies / is a copy of **,** gene(s) / part of DNA **;** **4** (RNA) passes , out of nucleus / through nuclear pore / into cytoplasm **;** **5** to / at **,** ribosome / RER **;** **6** ribosome made of (r)RNA **;** **7** (RNA needed for) protein synthesis / formation of polypeptides / AW **;** **8** amino acids brought by (t)RNA **;**	5	The type of RNA does not need to be specified but, if stated, **AWARD** only if used in the correct context. **1** Must be a clear statement **1 ACCEPT** proteins make antibodies **1 ACCEPT** antibodies are polypeptides **3 ACCEPT** (m)RNA involved in transcription of DNA **3 IGNORE** transcription unqualified **3 ACCEPT** 'a section of DNA acts as a template for RNA' if the idea of RNA copying part of DNA is clearly present **5 ACCEPT** in context of mRNA or tRNA **6 IGNORE** 'ribosomal RNA' unqualified **7 IGNORE** translation unqualified
			QWC: 2 roles of RNA **;** *Award if one mark is given from each of the shaded areas*	1	**AWARD** if marking point **3** or **4 plus** marking point **6** or **7** or **8** are seen

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Question			Answer	Marks	Guidance
2	(b)	(iii)	*if no other marks have been awarded, credit one mark max for* **Z** antibodies bind to antigens (on pathogen) **;** *otherwise, mark as follows:* **N1** neutralisation **;** **N2** antibodies , cover binding sites on pathogen / bind to toxins **;** **N3** prevent **,** binding / entry **,** to (host) cell **;** **A1** agglutination **;** **A2** clump / bind together , (many) pathogens **;** **A3** (clump) too large to enter host cell / increase likelihood of being consumed by (named) phagocyte**;** *the following could be credited* **O1** opsonisation **;** **O2** activation of complement **;** **O3** increase likelihood of being consumed by (named) phagocyte **;** **L1** lysins **;** **L2** destroy / AW **,** pathogens **;**	4	With the exception of L2, if name does not match description, **IGNORE** description and mark name **N1 CREDIT** derived term eg neutralised **N3 IGNORE** 'harm host cell' unqualified **N3 ACCEPT** 'prevent (host) cell becoming infected' **A1 CREDIT** derived term eg agglutinated **A1 ACCEPT** 'agglutinisation' **A3 IGNORE** 'white blood cell' **A3 DO NOT CREDIT** lymphocyte **A3 ACCEPT** neutrophils / macrophages / monocytes **O3 IGNORE** white blood cell **O3 DO NOT CREDIT** 'lymphocyte' **O3 ACCEPT** neutrophils / macrophages / monocytes **L2** Must be in context of lysins

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Question			Answer	Marks	Guidance
2	(c)	(i)		4	**E** marks can be awarded without awarding corresponding **G** mark unless clearly incorrect in context *Mark the first two groups of people mentioned max 2 marks for each group*
			G1 patients with , HIV^+ / AIDS / transplant / chemotherapy **;**		**G1 ACCEPT** 'patients with weak immune system' **but do not** also credit for E1, **G1 ACCEPT** 'cancer' **IGNORE** 'homeless people'
			E1 weak immune system / cannot produce (many) antibodies ;		
			G2 pregnant women **;**		**G2 IGNORE** babies (as close to stem)
			E2 foetus / embryo , has undeveloped immune system **or** antibodies can cross placenta **;**		**E2 ACCEPT** 'baby as AW for embryo' **E2 IGNORE** weak immune system **E2 ACCEPT** underdeveloped immune system **E2 IGNORE** foetus gets antibodies from mother
			G3 health workers **or** people , living / working , close to outbreak **;**		**G3 ACCEPT** suitable named professional eg nurse / doctor **G3 ACCEPT** 'people who have been in contact with disease' unqualified **G3 IGNORE** refs to overcrowding **G3 IGNORE** 'working with animals' unless it is clear that the animals are infected
			E3 likely to be at (increased) risk (of disease) **;**		**E3 ACCEPT** ref to health workers being important in control of outbreak
			G4 those with (named) chronic diseases **;**		**G4** eg asthma / diabetic / heart disease / TB / autoimmune disease **G4 IGNORE** 'lung disease' **G4 IGNORE** 'homeless people'
			E4 *idea of* inability to withstand further disease / already being in poor health **;**		**E4 ACCEPT** idea of weakened immune system for this marking point **if not credited in E1 or G1**

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Question			Answer	Marks	Guidance
2	(c)	(ii)	*idea of* days lost at work / effect on economy ; *idea of* costing more to deal with the ill people (than the cost of vaccination) ; **ora** *idea of* response to public opinion ; *idea of* health service unable to cope ; *idea of* eliminating a disease ;	1	**DO NOT CREDIT** ref to antibiotics treating viruses
2	(c)	(iii)	*idea of:* being too busy / can't be bothered / feel it is unnecessary ; lack of trust in government ; media scare stories ; concerned about side effects ; cost implication to individuals ; allergic to vaccine ; altruistic reason / other people more deserving ; fear of needles ; religious / cultural / ethical , reasons ;	1	**IGNORE** 'risk' unqualified throughout **ACCEPT** 'conflicting research' **IGNORE** 'not natural'
			Total	**21**	

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Question			Answer	Marks	Guidance
3	(a)		globular ; catalysts ; intracellular ; extracellular / hydrolytic ; inhibitors ;	5	**Mark the first answer on each prompt line.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **DO NOT CREDIT** metabolic (as given in Q) **DO NOT CREDIT** digestive (as given in Q)

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Question			Answer		Marks	Guidance
3	(b)		1	carry out with and without , Ca^{2+} / cofactor ;	5	**1 ACCEPT** 'use a control with no calcium' **1 ACCEPT** calcium as AW for Ca^{2+} as the question is testing AO3 **1 IGNORE** increase / decrease , concentration
			2	*idea of* using at least three concentrations (of Ca^{2+}) (other than zero) ;		**2 ACCEPT** implication of 3 or more concentrations, e.g. 'use several concentrations'
			3	keep , concentration / volume of , enzyme / rennin, constant ;		**3 IGNORE** amount
			4	keep , concentration / volume of , caseinogen / substrate / milk, constant ;		**4 IGNORE** amount
			5	keep , temperature / pH , constant ;		**5 IGNORE** 'use a water bath' unqualified
			6	measure / AW , appearance of , product / casein **or** measure disappearance of , substrate / caseinogens **or** assess cloudiness (of solution) ;		**6** *This mp is for measurement of the dependent variable* **6 ACCEPT** observe as AW for measure appearance disappearance **6 ACCEPT** filter **and** weigh **6 ACCEPT** 'assess degree of solubility / insolubility'
			7	over time intervals / after fixed time / end point time ;		**7** 'measure how much substrate is left after 30 min' = 2 marks (mp 6 and 7)
			8	replicates / repeats ;		**8 IGNORE** repeat / replicate on its own – must imply minimum of 3 in total, i.e. original plus two

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Question			Answer		Marks	Guidance
3	(c)		1	*idea of* cofactors / minerals , being **,** recycled / used again **;**	1	
			2	*idea that in enzyme action* total mass of **,** cofactor / coenzyme **,** very small compared to total mass of protein **;**		**2 AWARD** only if the enzyme context is clearly stated
			3	*idea that* proteins are used for purposes other than enzymes **;**		**3 CREDIT** stated example, e.g. muscle / hormones / antibodies. **3 IGNORE** growth / repair / replace
			4	proteins are not stored in the body but vitamins and minerals are **;**		
			5	some enzymes don't need cofactors **;**		
				Total	**11**	

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Question			Answer	Marks	Guidance
4	(a)		(contains) all of the / every / each , nutrient(s) / food groups / components / constituents **or** (contains the), nutrients / food groups / components / constituents, needed for health **or** (contains) fat and protein and carbohydrate and minerals and vitamins (and , fibre / roughage , and water) **;** in correct / right / suitable, proportions / amount / quantity / level **;**	2	**IGNORE** factors / things , as AW for nutrients **IGNORE** refs to energy **IGNORE** 'adequate / sufficient / enough' as this implies minimum **IGNORE** 'balanced' as this is part of the term they are defining **IGNORE** 'match consumption with use'

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Question			Answer		Marks	Guidance
4	(b)	(i)			3	**Mark the first answer on each prompt line.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **IGNORE** 'energy source'
			1	membranes **;**		**1 ACCEPT** 'phospholipid bilayer'
			2	absorption of fat soluble vitamins **;**		
			3	electrical insulation / insulation of , neurones / nerve cells / axons **;**		**3 ACCEPT** insulation in context of myelin / Schwann cells
			4	(thermal) insulation **;**		**4 IGNORE** refs to thermoregulation
			5	protection of organs **;**		**5 IGNORE** 'protect cells / padding'
			6	(source of) (steroid) hormones / named steroid hormone / named group of steroid hormones **;**		**6** e.g. testosterone, oestrogen, progesterone, aldosterone , glucocorticoids, androgens
			7	(source of) cholesterol / LDL / HDL **;**		
			8	waterproofing / skin suppleness / sebum **;**		**8 ACCEPT** ear wax
			9	source of vitamin D **;**		
			10	buoyancy **;**		

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Question			Answer		Marks	Guidance
4	(b)	(ii)	1	(leads to) increased / AW , cholesterol / LDL ;	3	**1 IGNORE** 'low density lipid' **1 IGNORE** cholesterol unqualified. Answers must imply that the level of cholesterol (in the body) is raised
			2	cholesterol / fat , deposited , in arterial walls / under endothelium ;		**2 ACCEPT** 'LDL deposited in arterial wall' **2 ACCEPT** epithelium / lining , as AW for endothelium
			3	increase risk of / leads to , atherosclerosis / atheroma / plaque formation ;		**3 ACCEPT** 'causes atherosclerosis'
			4	narrowing / blocking , of artery lumen ;		**4 ACCEPT** 'sticking out into artery lumen'
			5	increased risk of / leads to , CHD / angina / stroke / hypertension / high blood pressure / heart attack / myocardial infarction / gallstones ;		**5 DO NOT CREDIT** if candidates think the C stands for 'chronic' **5 ACCEPT** mis-spellings of 'coronary' which cannot be confused with chronic **5 ACCEPT** 'causes heart disease' **5 IGNORE** diabetes / arthritis as directly related to obesity

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<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>4</td><td>(c)</td><td></td><td>
<table>
<tr><th></th><th>triglyceride</th><th>phospholipid</th><th></th></tr>
<tr><td>difference</td><td>3 fatty acids</td><td>2 fatty acids</td><td>;</td></tr>
<tr><td>difference</td><td>3 ester bonds</td><td>2 ester bonds</td><td>;</td></tr>
<tr><td>difference</td><td>absence of phosphate</td><td>presence of phosphate</td><td>;</td></tr>
</table>
<table>
<tr><td>similarity</td><td>(contain) glycerol</td><td>;</td></tr>
<tr><td>similarity</td><td>(contain) fatty acids</td><td>;</td></tr>
<tr><td>similarity</td><td>(contain) ester bonds</td><td>;</td></tr>
<tr><td>similarity</td><td>(contain elements) C,H and O</td><td>;</td></tr>
</table>
</td><td>4</td><td>Award one mark per correct row. CREDIT any correct (pair of) statement(s) in each row regardless of other information
2 max for differences
2 max for similarities

IGNORE molecule / group
IGNORE ‘hydrocarbon / hydrophobic / lipid , tail’ the first time it is seen but ECF if used as a synonym for ‘fatty acid’ in both difference and similarity

IGNORE molecule / group
DO NOT CREDIT if an incorrect element stated

ACCEPT ‘C, H and O atom’
DO NOT CREDIT molecule / group</td></tr>
<tr><td>4</td><td>(d)</td><td>(i)</td><td>emulsion (test) ;</td><td>1</td><td>ACCEPT ‘emulsification / white emulsion / Sudan III’
IGNORE refs to translucent grease mark test’</td></tr>
</table>

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Question			Answer	Marks	Guidance
4	(d)	(ii)	*emulsion test* **1** add , ethanol / alcohol , (to sample) **;** **2** shake / stir / agitate / mix thoroughly / AW **;** **3** add (to) water **;** *If candidate is clearly describing Sudan III test* **5** mix sample with water **;** **6** add Sudan III (stain) **;** **7** shake / stir / agitate / mix thoroughly / AW **;** *If candidate is describing translucent grease mark test* ***AWARD*** *one mark only* **;**	3	*Max 2 if step 1,2 3 are in different sense order but* ***IGNORE*** *any ref to shaking after adding water, i.e. 1, 2, 3, 2.* **2 IGNORE** 'mix' unqualified **2** not dependent on correct chemical in mp **1** **3** not dependent on correct chemical in mp **1**
4	(d)	(iii)	(mixture) turns, cloudy / milky / white **;**	1	**DO NOT CREDIT** 'precipitate' **ACCEPT** 'red layer floating to top' if Sudan III test has been described in part (ii) **ACCEPT** 'translucent stain is permanent / AW'
			Total	**17**	

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Question			Answer		Marks	Guidance
5	(a)			*idea that:*	2	**CREDIT** any valid point where seen
			1	not all , areas explored / species yet discovered **;**		**1 ACCEPT** 'not all species have been identified (yet)' **1 IGNORE** 'yet to be named' **1 IGNORE** refs to speciation **1, 2, 3 ACCEPT** 'organism' as AW for species as it is an '*idea that*' marking point
			2	microscopic / small / nocturnal / camouflaged , species difficult to see **;**		
			3	sampling might miss rare species **;**		
			4	organisms mistakenly identified as one species may actually be two (or more) species **;**		
			5	concept of species is difficult to define **;**		

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Question			Answer		Marks	Guidance
5	(b)	(i)			3	Marking points 1-5 must be stated in words, not implied by figures
			1	both / assessed **and** threatened , show increase **;**		**1 IGNORE** both are similar shape unqualified **1 ACCEPT** general statement or referring to given time period **1 ACCEPT** assessed and threatened show positive correlation
			2	number of assessed (species) , always / AW , higher (than threatened species) **; ora**		
			3	*idea of*: widening gap between assessed (species) and threatened (species) / higher rate of increase for assessed species **;**		
			4	between 2000 and 2002 / in first two years , both / assessed **and** threatened , were level / AW **;**		**4 IGNORE** 'at the start' answers must mention years
			5	after 2004 , both / assessed **and** threatened , have, reduced rate of increase / slower increase / AW **;**		**5 IGNORE** 'between 2004 and 2005' answers must imply whole of subsequent time period
			6	figures to support any above statement **;**		**6** figures must support another point that has been credited **6** Answers must quote numbers for total assessed species **and** for threatened species along with two years **6 ACCEPT** calculated comparisons

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Table of acceptable figures:

Year	total number of species	total species threatened	increase in total number of species since 2000	increase in number of species threatened since 2000	acceptable range for % of total
2000	16500	11500	-	-	65 - 75
2001	16500	11500	0	0	65 - 75
2002	16500	11500	0	0	65 - 75
2003	22000	12500	5500	1000	53 - 60
2004	38000	15500	21500	4000	39 - 43
2005	38500	15500	22000	4000	38 - 42
2006	40000	16500	23500	5000	40 - 43
2007	41500	16500	25000	5000	38 - 41
2008	45000	17000	28500	5500	36 - 39
2009	47500	17500	31000	6000	35 - 38
2010	57500	18500	41000	7000	31 - 33
	accept +/- 500	accept +/- 500	accept +/- 1000	accept +/- 1000	

Examples of acceptable figure quotes to support each point

mp1 "between 2000 and 2009 total assessed species increase by 31000 and threatened species increase from 11500 to 17500"

mp2 "in 2004 total assessed species was 38000 and threatened was 15500"

mp3 "in 2000 there were 5000 more assessed species than threatened, in 2006 the gap was 23500"

mp4 "between 2000 and 2002 assessed species were 16500 and threatened were 11500"

mp5 "in the 4 years before 2004, total species rose by 21500 and threatened by 4000. In the 4 subsequent years total assessed rose by13000 and threatened rose by 1500."

5	**(b)**	**(ii)**	31 / 32 / 33 **;;**	2	Correct answer = 2 marks If answer incorrect, **AWARD** 1 mark for 18,500 (± 500) ÷ 57,500 (± 500) **or** If answer not given to the nearest whole number **AWARD** 1 mark for any figure between 31.0 and 33.4

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5	(b)	(iii)	1 a	*(total species assessed is increasing because)* , *idea of* more sampling / exploration (leads to more species identified)	2	**1 IGNORE** refs to speciation as time frame too short
				or		
			b	improved identification , techniques / described **;**		**1** eg DNA fingerprinting **1 IGNORE** study if used in the context of species that have already been identified
			2 a	*(threatened species is increasing because)* , loss of habitat		**IGNORE** idea of conservation not working
				or		
			b	climate change		
				or		
			c	increased human population		**IGNORE** refs to hunting
				or		
			d	*idea of* interspecific competition from introduced species		**IGNORE** 'competition from newly discovered species' as this implies that the candidate thinks the species was not present until it was discovered
				or		
			e	*idea that* some of the newly-identified species are likely to be threatened **;**		e.g 'as more species are discovered, the number of threatened species will go up'
			3 a	*(there is a widening gap between total and threatened species because)* , new species tend to be discovered in areas where humans don't live so they are not threatened		
				or		
			b	conservation techniques are working / AW **;**		

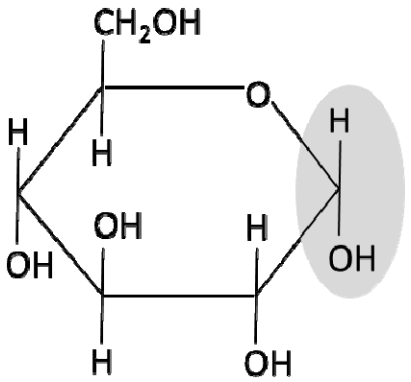
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Question			Answer	Marks	Guidance
5	(c)		range / number , of habitats / ecosystems ; genetic variation (within species) ;	1	**CREDIT** only these answers

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Question				Answer	Marks	Guidance
5	(d)				4	If correct points included under the wrong headings then award **max 1** for that convention **ACCEPT** suitable synonyms for trade throughout, e.g. 'buying and selling'
				CITES *2 max*		
			C1	regulate / monitor / prevent , trade in , selected / certain / endangered , species		**C1 ACCEPT** ref to products from endangered species, e.g. leopard skin **C1 ACCEPT** 'illegal' as AW for 'selected / AW'
			C2	ensure (international) trade does not endanger , wild populations / AW **;**		**C2 DO NOT AWARD** if 'all trade in wild plants' stated
			C3	prohibit (commercial) trade in wild plants **;**		
			C4	allow trade in , artificially propagated plants / AW **;**		
			C5	allow (some) trade in less endangered **,** wild species / organisms / animals and plants **;**		
				Rio Convention *2 max*		
			R1	sustainable use of **,** organisms / habitats / ecosystems **;**		**R1 ACCEPT** example e.g. replanting trees / fishing quotas / large mesh size
			R2	share genetic resources **;**		**R2 AWARD** in context of access to or benefits from genetic resources
			R3	share access to **,** scientific knowledge / technology **;**		
			R4	*idea of* promoting (named) *ex situ* conservation method(s) **;**		**R4** e.g. 'set up seed banks' / 'captive breeding programmes' **R4 IGNORE** 'zoos' unqualified **R4 IGNORE** 'in situ'
			R5	*idea of* raising profile of (biodiversity) with , governments / public bodies / general public **;**		**R5 ACCEPT** 'take biodiversity into account during planning processes' **R5 ACCEPT** 'informing people that it is their duty to consider biodiversity'
			R6	*idea of* international cooperation (on biodiversity issues) **;**		
				Total	**14**	

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Question			Answer	Marks	Guidance
6	(a)		monosaccharide(s) ;	1	**ACCEPT** phonetic spelling
6	(b)	(i)	*identical to diagram of β-glucose with* inversion of OH and H on any **one** carbon atom ; correct inversion of OH and H on 1st C ;	2	A correct diagram as shown below = 2 marks  **ACCEPT** displayed formula for CH_2OH etc If the candidate has drawn α-glucose upside down = 0 marks

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Question				Answer	Marks	Guidance
6	(b)	(ii)			2	*Answers need a feature plus an explanation of how the feature helps the function*
			1	soluble so can be (easily) , transported / carried (around organism) **;**		**1 ACCEPT** soluble so is able to , react / AW **1 ACCEPT** description of solubility in terms of chemical properties linked to transport or reactivity
			2	small (molecule) so can , be transported / diffuse , across (cell) membranes **;**		
			3	easily / quickly , respired / oxidised / broken down , to , release energy / produce ATP **;**		**3 DO NOT CREDIT** 'hydrolysed' **3 DO NOT CREDIT** 'easily broken down to provide energy for respiration' **3 DO NOT CREDIT** 'easily broken down to produce energy'
			4	molecules can , join / AW , to produce , (named) disaccharides / (named) polysaccharides **;**		**4 IGNORE** 'used to form glycogen' without idea of molecules , bonding / joining / condensation
6	(c)				3	**AWARD** making points from suitably labelled diagram
			1	part of nucleotide **;**		
			2	bonded / joined / attached , to (named) base **and** phosphate **;**		**2 IGNORE** 'made up of' **2 DO NOT CREDIT** answers which state incorrect bond **2 IGNORE** 'phosphate molecule'
			3	phosphate (joined) to C5 (and C3) / base (joined) to C1 **;**		
			4	(deoxyribose is part of) backbone (of DNA) **;**		
			5	*idea of* linking with (second) phosphate on adjacent nucleotide **;**		
			6	nucleotide is , monomer / repeating unit , of DNA / polynucleotide **;**		**6 ACCEPT** 'DNA formed from a chain of nucleotides'

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Question			Answer		Marks	Guidance
6	(d)	(i)	1	α-glucose / β-glucose ;	3	**Mark the first answer on each prompt line.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** *Candidates may **identify** the error or **correct** the error* **If nothing is written on the answer lines, ACCEPT** a clear indication on the boxed list of which statements are incorrect **1 ACCEPT** b / B for 'β'
			2	some / no , 1–6 bonds **or** only 1 –4 bonds ;		
			3	condensation / hydrolysis ;		
			4	branches / straight chain ;		
6	(d)	(ii)		glycogen / amylopectin ;	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **IGNORE** starch **DO NOT CREDIT** if spelling could be confused with another molecule, e.g. glucagon
				Total	**12**	

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Question			Answer	Marks	Guidance
7	(a)		*idea that* (dairy) animals use plants for food **;** plants are the basis of all food chains **;** (some) yoghurts contain , (named) fruit / plant (flavouring) **;**	1	e.g. cows eat grass / cows are herbivores **IGNORE** refs to microorganisms

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Question			Answer	Marks	Guidance
			advantages **A1** low in **,** saturated fat / cholesterol **; ora**		**IGNORE** refs to obesity / weight loss **ACCEPT** ref to protein produced by bacteria **A1 ACCEPT** 'no , cholesterol / saturated fat' **A1 ACCEPT** implication that fat is saturated , e.g. ,fat that leads to high blood cholesterol **A1 IGNORE** 'animal fat' unqualified
			A2 less likely to cause , heart disease / atherosclerosis / AW **;**		
			A3 no / fewer , animal welfare / moral / ethical / religious, issues **;**		**A3 ACCEPT** **'**suitable for , vegetarians / vegans' **A3 ACCEPT** refs to fewer animals being slaughtered
			A4 source of essential amino acids **;**		
			A5 high rate of (protein) production **;**		**A5 IGNORE** 'high yield' answers must imply rate
			A6 *idea of* fewer energy losses / more energy efficient **;**		**A6 IGNORE** 'efficient' unqualified **A6 ACCEPT** 'more efficient because lower down food chain'
			A7 *idea that* production can be changed more easily (according to demand) **;**		**A7** Answers could be in context of rate or content
			A8 *idea that* cheaper to produce (once established) **;**		**A8 IGNORE** 'uses fewer resources'
			A9 uses less , land area / space **;**		**A9 IGNORE** 'uses fewer resources'
			A10 (might be) grown on (plant) waste **;**		**A10** needs to be stated as an advantage
			A11 less risk of transfer of disease from animals **;**		**A11** e.g. CJD, salmonella from eggs
			A12 can be produced in any , climate / season **;**		

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Question			Answer	Marks	Guidance
7	(b)		*disadvantages* **D1** different **,** taste / texture / palatability **;** **D2** lacks / less , iron **;** **D3** needs to be processed (to add **,** taste / texture) **;** **D4** *idea of* consumer resistance **;** **D5** growth conditions suit , pathogenic / harmful / spoilage , microorganisms / bacteria / microbes **;** **D6** need for **,** isolation / purification (of protein from material on which they grow) **;** **D7** may require removal of **,** toxins / (excess) RNA **;** **D8** loss of farming jobs **;** **D9** *idea of* higher set up costs **;**	7	**D4 ACCEPT** e.g. 'people don't want to eat something made from fungus' **D4** 'people prefer flavour of meat' = 2 marks (D1 and D4) **D5 ACCEPT** 'food might be contaminated with bacteria etc' **D5 IGNORE** mould / bad bacteria **D6 ACCEPT** 'purification of food from waste' **D9 IGNORE** 'expensive' unqualified **D9 ACCEPT** 'equipment costs a lot''
			QWC - balanced account	1	**Award** if **2 A** marks **and 2 D** marks have been awarded

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<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>7</td><td>(c)</td><td></td><td>
<table>
<tr><th>method</th><th>description</th><th></th></tr>
<tr><td>freezing</td><td>1 slows / reduces / AW , <u>enzyme</u> , activity / AW

2 removes available water / AW
max1</td><td>;</td></tr>
<tr><td>pickling</td><td>(low pH) denatures , enzymes / proteins</td><td>;</td></tr>
<tr><td>irradiation</td><td>(microbial) DNA / genes / genetic material , destroyed / damaged / changed / mutated / disrupted</td><td>;</td></tr>
</table>
</td><td>3</td><td>Award one mark per box

1 ACCEPT ‘too cold for enzymes to work effectively’
1 DO NOT CREDIT refs to enzymes becoming denatured
1 IGNORE ‘stops / disrupts (enzyme activity)’

2 ACCEPT ‘ice crystals puncture cell membrane’

DO NOT CREDIT high pH
ACCEPT correct description of denaturation, e.g. ‘shape of active site changed’
IGNORE refs to osmosis

IGNORE ‘mutation’ without ref to genetic material</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>12</td><td></td></tr>
</table>

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<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>8</td><td></td><td></td><td>
<table>
<tr><th>Biological Term</th><th>Description</th></tr>
<tr><td>Natural Selection</td><td>The theory proposed by Darwin on the evolution of species</td></tr>
<tr><td>Speciation</td><td>The formation of a new species ;</td></tr>
<tr><td>Continuous variation ;</td><td>Differences between individuals that cover a range of values rather than discrete categories</td></tr>
<tr><td>Adaptation</td><td>a variation that increases the chances of survival ;</td></tr>
<tr><td>Binomial ;</td><td>A system of naming organisms that uses two scientific (Latin) names for species</td></tr>
<tr><td>ex situ ;</td><td>The type of conservation of which seed banks are an example</td></tr>
<tr><td>Environmental Impact Assessment / EIA ;</td><td>A study carried out by a local planning authority in order to judge the effect of a development on the biodiversity of an area.</td></tr>
</table>
</td><td>6</td><td>IGNORE ‘founding a new species’
IGNORE refs to classification / naming
ACCEPT descriptions of mechanism of speciation

ACCEPT ‘something that helps survival’

DO NOT CREDIT ‘EIA’ if wrong words given
IGNORE ‘environmental impact survey’</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>6</td><td></td></tr>
</table>

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APPENDIX 1

Mark Scheme Conventions

The following conventions appear in the Mark Scheme

1. Bracketed words. The words in brackets are there to 'set the scene' and indicate the context in which the answer is expected. They do not need to appear. Award the mark as long as the statement in the brackets is not contradicted.

2. Solidus /. A solidus indicates alternative ways that a mark might be gained for a given Mark Point.

3. Use of the comma in a mark point. This indicates that some information from either side of the comma or commas is needed. It is used in conjunction with the solidus.
   e.g. 'parasite gains , nutrition / energy , from host ; **MP3 Q2 (a)**

   This means that to get the mark, the response needs to mention the idea of either nutrition or energy being obtained, and where it comes from in terms of the host.

   Note in this example that no word or term is underlined and so alternative wording (AW) that clearly conveys the same idea is acceptable. In some cases the Guidance column may indicate examples of wording or terms that are acceptable (ACCEPT) or that should be ignored (IGNORE). In the case of IGNORE read on to see if something creditworthy appears later in the response.

4. Underlining.
   - solid underline. The word or part of word underlined is required but minor mis-spellings are acceptable as long as the word is phonetically the same

     e.g. (thermal) insulation; **MP4 Q4 (b)(i)**

     'insulation' as an answer on its own gains a mark as it does not contradict 'thermal'. Alternatives like keeping the body warm would not gain credit, but the response might say something equally creditworthy like 'insulating the body' and gain credit.

   - wavy underline. This indicates that whilst the word underlined is not precisely needed, alternative responses need to be closely related in meaning or be a clear description.

5. *idea of.* This is used as a prefix to marking points where there may be a fairly wide range of responses which cover the essence of the required response. This often requires examiner judgement. These often, but not exclusively, appear in questions such as those related to environmental or health issues.

   e.g. *idea of* raising the profile of biodiversity with , governments / public bodies / general public ; **MP R6 Q5(d)**

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RECOGNISING ACHIEVEMENT

Monday 21 May 2012 – Afternoon

AS GCE BIOLOGY

F212 Molecules, Biodiversity, Food and Health

Candidates answer on the Question Paper.

OCR supplied materials:
None

Other materials required:
- Electronic calculator
- Ruler (cm/mm)

Duration: 1 hour 45 minutes

F2100706111

F 2 1 2

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined pages at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **100**.
-  Where you see this icon you will be awarded marks for the quality of written communication in your answer.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.
- This document consists of **24** pages. Any blank pages are indicated.

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Answer **all** the questions.

1 Enzymes are important in a wide range of biological reactions.

(a) Fig. 1.1 represents a mechanism of enzyme action.

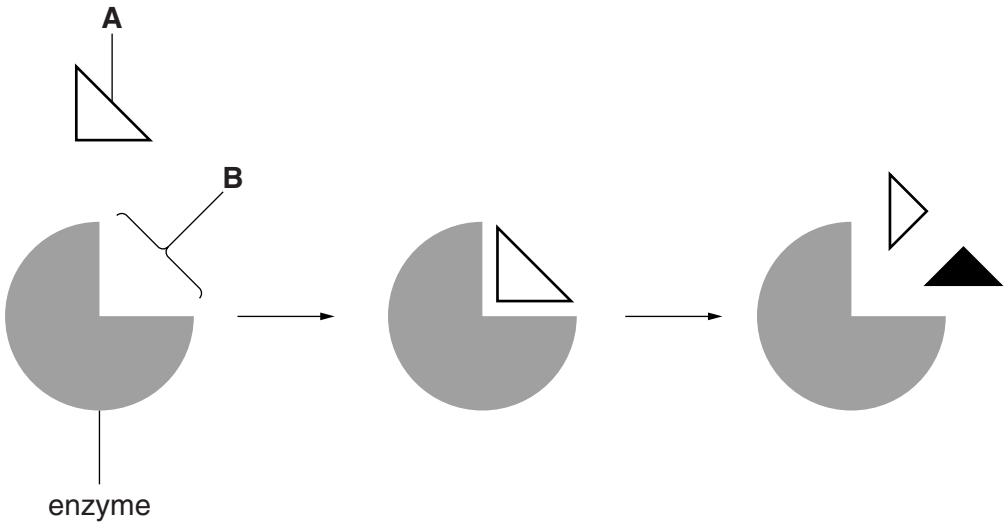


Fig. 1.1

(i) Name the structures represented by the letters **A** and **B**.

A .....

B ..... **[2]**

(ii) The mechanism of enzyme action was originally explained in terms of the 'lock-and-key model'. It is now more often explained in terms of the 'induced-fit' model.

Suggest why the lock-and-key and induced-fit explanations are termed **models**.

.....

.....

..... **[1]**

(iii) Suggest why most scientists now accept the induced-fit model rather than the lock-and-key model.

.....

.....

..... **[1]**

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(b) Many fish live in the Antarctic where the water temperature can be close to 0 °C.

- Scientists have studied enzymes from these Antarctic fish and also from non-Antarctic fish that live in water at a temperature of 10 °C.
- One of the enzymes studied has been lactate dehydrogenase (LDH), an important enzyme involved in cell metabolism.
- One way in which LDH works is to catalyse the conversion of lactate to an important compound known as pyruvate.

(i) Scientists investigated the rates of reaction of LDH from Antarctic and non-Antarctic fish at a range of temperatures.

Suggest **three** variables that should be controlled in an investigation of this type.

1 .....

2 .....

3 ..... **[3]**

(ii) Some suggested controls used in this investigation are listed below.

J	water, lactate and heated LDH (non-Antarctic at 10 °C)
K	lactate alone at all temperatures
L	lactate and water at all temperatures
M	boiled LDH (Antarctic and non-Antarctic) at all temperatures
N	pyruvate and water at all temperatures

Select the letter, **J**, **K**, **L**, **M** or **N**, that represents the most appropriate control to be used in this investigation.

..... **[1]**

(iii) The rate of conversion of lactate to pyruvate at 1 °C was found to be relatively slow when catalysed with LDH from **non-Antarctic fish**.

Suggest reasons for this result.

.....

.....

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.....

..... **[2]**

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(iv) It was discovered that the rate of conversion of lactate to pyruvate at 1 °C was higher if catalysed with LDH enzyme from Antarctic fish than when catalysed with LDH enzyme from non-Antarctic fish.

Certain parts of the enzyme molecule from the Antarctic fish are more flexible than the equivalent parts of the molecule from the non-Antarctic fish.

Suggest how a more flexible structure might help this enzyme work faster at lower temperatures.

.....

.....

..... **[1]**

(c) Enzymes are proteins. The enzymes in Antarctic fish have a different structure from those found in non-Antarctic fish.

(i) Suggest how the structure of the **enzymes** may differ in Antarctic and non-Antarctic fish.

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..... **[2]**

(ii) Suggest how the **DNA** of the Antarctic and non-Antarctic fish might differ.

.....

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..... **[2]**

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(d) If species of Antarctic fish were to become extinct, their unique enzymes would be lost.

(i) Suggest why the loss of these **enzymes** might be undesirable.

.....

.....

..... **[1]**

(ii) Suggest **two** ways in which the population of Antarctic fish could be conserved.

.....

.....

.....

..... **[2]**

[Total: 18]

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2 Living organisms can be classified into five kingdoms, based on certain key characteristics.

(a) Table 2.1 shows some of the characteristics of the five kingdoms.

Complete the table.

Table 2.1

kingdom	membrane-bound organelles	cell wall	type(s) of nutrition
prokaryote	absent	present – made of peptidoglycan	
	present	sometimes present – composition varies	heterotrophic and autotrophic
fungi		present – made of chitin	heterotrophic
	present		autotrophic
animal		absent	heterotrophic

[6]

(b) An unknown species is discovered. Its cells contain many nuclei scattered throughout the cytoplasm of thread-like structures.

Suggest the kingdom to which this species belongs.

..... **[1]**

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(c) Living organisms can also be classified into three groups called **domains**.

Outline the features of this system of classification compared with the five kingdom system.

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..... **[3]**

[Total: 10]

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3 Bats are the only mammals that can truly fly. Many species of bat hunt flying insects at night. Bats are able to use sound waves (echolocation) in order to help them find their prey in the dark.

(a) Suggest how the ability to use echolocation may have evolved from an ancestor that did not have that ability.

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..... **[4]**

The pipistrelle is the most common species of bat in Europe. It was originally thought that all pipistrelles belonged to the same species, *Pipistrellus pipistrellus*. However, in the 1990s, it was decided that there were two species: the common pipistrelle, *Pipistrellus pipistrellus* and the soprano pipistrelle, *Pipistrellus pygmaeus*.

Data for both species are provided in Table 3.1.

Table 3.1

species	mean body mass (g)	mean wingspan (m)	range of echolocation call (kHz)	colour
common pipistrelle	5.5	0.22	42–47	medium to dark brown
soprano pipistrelle	5.5	0.21	52–60	medium to dark brown

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(b) (i) Name the genus to which the soprano pipistrelle belongs.

..... **[1]**

(ii) Using the data in Table 3.1, suggest why pipistrelles were originally classified as one species.

.....

.....

..... **[1]**

(iii) State **two** pieces of **molecular** evidence that can be used to identify organisms as belonging to different species.

.....

..... **[2]**

(iv) Describe how it is possible to confirm, over a longer period of time, whether two organisms belong to different species or the same species.

.....

.....

.....

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.....

..... **[2]**

QUESTION 3(c) STARTS ON PAGE 10

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(c) The soprano pipistrelle has an echolocation call that is 'high pitched' (between 52 and 60 kHz). The common pipistrelle has an echolocation call that is 'low pitched' (between 42 and 47 kHz).

Variation within and between species can be as a result of genetic or environmental factors. Whatever the causes of variation, the type of variation displayed can occur in two different **forms**.

Using the pipistrelle as an example, describe the key features of both **forms** of variation.

In your answer you should make it clear how genes and environment relate to each form of variation.

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..... **[7]**

[Total: 17]

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PLEASE DO NOT WRITE ON THIS PAGE

QUESTION 4 STARTS ON PAGE 12

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4 Fig. 4.1 shows a representation of part of a carbohydrate molecule called agarose.

One of the subunits of agarose is a sugar called galactose.

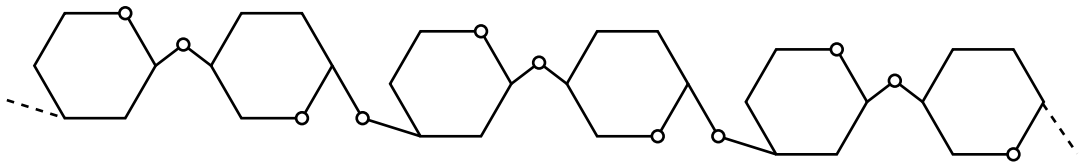


Fig. 4.1

(a) (i) Identify the type of carbohydrate molecule of which the carbohydrate agarose is an example.

..... **[1]**

(ii) Starch contains a carbohydrate called amylose. Amylose does not contain galactose.

Using the information in Fig. 4.1, identify **one** similarity and **one further** difference in structure between agarose and amylose.

similarity .....

.....

.....

difference .....

.....

..... **[2]**

(b) Agarose forms part of a more complex carbohydrate called agar, which is used as a growth medium for bacteria. Bacteria cannot break down the agarose in agar.

Suggest why bacteria cannot break down agarose.

.....

..... **[1]**

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(c) A student wished to demonstrate experimentally that bacteria cannot break down agarose.

The student used a culture of *E.coli* bacteria which had been grown in a solution containing starch.

Two tubes, **A** and **B**, were set up as follows:

Tube **A**: contained 0.1 cm^3 of the *E.coli* culture and 5 cm^3 of a nutrient solution in which agarose was the only carbohydrate.

Tube **B**: contained 5 cm^3 of a nutrient solution in which agarose was the only carbohydrate.

Both tubes were incubated at 30 °C for 2 hours.

A sample from each tube was then tested for the presence of reducing sugar.

The results are shown in Table 4.1.

Table 4.1

source of sample	conclusion from test
tube **A**	very small amount of reducing sugar present
tube **B**	no reducing sugar present

(i) Explain the purpose of tube **B**.

.....

.....

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..... **[2]**

(ii) The student wrote the following conclusion:

My experiment showed that bacteria must be able to break down agarose. This is because reducing sugar was present in tube ***A***.

Suggest an alternative explanation for the presence of reducing sugar in tube **A** that is **not** consistent with the student's conclusion.

.....

.....

..... **[1]**

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(iii) Suggest **two** ways in which the **reliability** of the experiment could be improved.

1 .....

.....

2 .....

..... **[2]**

(d) (i) The student did **not** have access to a colorimeter when testing solutions for the presence of reducing sugar.

Describe how the student could carry out a chemical test for reducing sugar **and** suggest how he could estimate the amount of reducing sugar in the sample from tube **A**.

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..... **[5]**

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(ii) Another student suggested that the agarose may have been broken down to a **non-reducing** sugar.

Describe how the test for reducing sugar could be modified to investigate this hypothesis.

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..... **[3]**

[Total: 17]

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5 **(a)** An investigation was carried out into the effect on lung function on giving up smoking.

The investigators measured the maximum volume of air that could be exhaled in one second (FEV_1) in a group of people who had stopped smoking, and in a similar group of people who continued to smoke over a five year period.

The results are shown in Fig. 5.1.

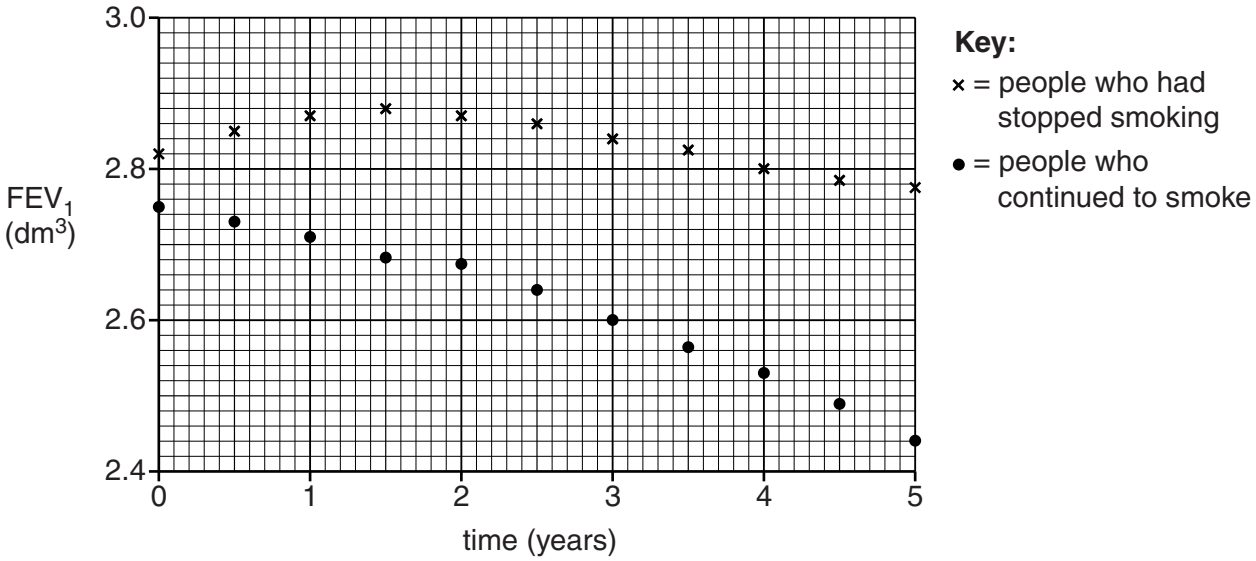


Fig. 5.1

(i) Using the information in Fig. 5.1, calculate the percentage decrease in the FEV_1 over the 5 year period for the group of people who **continued to smoke**.

Show your working. Give your answer to **one decimal place**.

Answer = ... % **[2]**

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(ii) Describe the trends shown by the results in Fig. 5.1.

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..... **[4]**

QUESTION 5(b)(i) STARTS ON PAGE 18

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(b) (i) One of the symptoms of smoking is the development of a smoker's cough.

Explain how smoking causes a smoker's cough **and** how the cough itself can lead to further problems in the lungs over a long period of time.



In your answer you should clearly distinguish between the development of the cough and the effects of prolonged coughing.

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..... **[7]**

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(ii) Chronic obstructive pulmonary disease (COPD) is a combination of diseases that can result in coughing, breathing difficulties and fatigue.

Name **two** specific diseases that contribute to COPD.

1 .....

2 ..... **[2]**

(iii) One form of COPD develops because enzymes are released by phagocytes entering the alveoli. This enzyme action can break down elastin in the lining of the bronchioles and alveoli.

Use the example of elastin breakdown to explain the induced-fit hypothesis of enzyme action.

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..... **[5]**

[Total: 20]

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6 **(a)** The traditional English folk song, *The Derby Ram*, contains the lyric:

"As I went out to Derby, all on a market day
I spied the biggest ram, sir, that ever was fed on hay"

The song is likely to have been inspired by the successes of farmers in the eighteenth century who developed a sheep known as the 'Dishly Ram'. This ram gave rise to a breed which grew more quickly, producing more wool and meat than other varieties of sheep.

(i) Explain how it would be possible for farmers in the eighteenth century to produce a larger, more profitable variety of sheep from an existing flock of sheep.

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..... **[3]**

(ii) Since the eighteenth century, other ways of improving productivity in sheep have been developed.

State **one** further way of improving productivity that is used by modern farmers.

..... **[1]**

(b) Crop yield can be improved by the use of fertilisers. In the eighteenth century, these are likely to have been organic fertilisers in the form of manure or compost.

(i) Suggest how organic fertilisers improve the yield of plant crops.

.....

.....

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.....

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.....

.....

..... **[3]**

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(ii) Inorganic fertilisers are not directly toxic to living organisms. However, the excessive use of these fertilisers can lead to a reduction in the biodiversity of farmland.

Suggest how the excessive use of inorganic fertilisers on **farmland** can cause a reduction in its biodiversity.

.....

.....

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.....

.....

..... **[2]**

(iii) Explain why a reduction in biodiversity may present problems for **agriculture** in the future.

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.....

.....

..... **[3]**

[Total: 12]

QUESTION 7 STARTS ON PAGE 22

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7 Select the most appropriate term from the list below to complete the table.

abundance	**habitat**	**Simpson's diversity index**
biodiversity	**percentage cover**	**species evenness**
biased	**quadrat**	**species richness**
community	**quantitative**	**systematic**
dichotomous	**random**	**taxon**
ecosystem	**sample**	**transect**

definition	term
sampling in which the observer does not decide when and where to take measurements	
a representative group of organisms that are selected from a population	
an area in which an organism lives	
a measure of the relative numbers of individuals in each species	
the frequency of occurrence of plants in a particular area	
the number of species present in a particular area	

[6]

[Total: 6]

END OF QUESTION PAPER

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ADDITIONAL PAGE

If additional space is required, you should use the lined pages below. The question number(s) must be clearly shown.

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ADDITIONAL PAGE

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RECOGNISING ACHIEVEMENT

GCE

Biology

Advanced Subsidiary GCE

Unit **F212:** Molecules, Biodiversity, Food and Health

Mark Scheme for June 2012

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Annotations

Annotation	Meaning
	Correct answer
	Incorrect response
	Benefit of Doubt
	Not Benefit of Doubt
	Error Carried Forward
	Given mark
	Underline (for ambiguous/contradictory wording)
	Omission mark
	Ignore
	Correct response (for a QWC question)
	QWC* mark awarded
	Contradiction

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Subject-specific Marking Instructions

- Use **CON** when a correct response is associated with a piece of clearly incorrect science within the same statement and award no mark. However, a candidate should only miss out on **one** potential mark every time a CON is used.
- For questions in which the command word is 'suggest' ignore incorrect responses and credit a correct response wherever it occurs
- ora = 'or reverse argument'
- Accept phonetic spellings unless otherwise indicated
- All marks are stand-alone unless otherwise stated in Additional Guidance
- For 'idea of' marking points a wide range of wording is acceptable. The mark is to be awarded for the idea.
- Solid underline indicates a required term although correct spelling is not necessary unless indicated.
- Squiggly underline indicates a key idea that is central to the marking point but that does not need to be expressed in the exact word(s) on the mark scheme
- Commas separate key ideas that need to be included in a candidate's answer in order to gain credit
- Where a word or phrase is enclosed by brackets, the word or phrase does not need to be stated in order to gain the mark but the answer should not be inconsistent with that word or phrase.
- While every effort has been made to include suggestions on possible ways in which candidates are likely to phrase responses, candidates will occasionally make correct responses which have not been anticipated by the SSU team. In these circumstances it is expected that examiners will use their professional judgement or contact their team leader for clarification.

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Question			Answer	Marks	Guidance
1	(a)	(i)	A substrate ; B active site ;	2	**Mark the first answer on each prompt line.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then **= 0 marks.**
		(ii)	*idea of* simple representation of the , process / structure **or** *idea of* showing people how it works ;	1	**Examples of acceptable responses** 'to make the process easy to understand' 'it is a visual representation' **IGNORE** 'because you don't know exactly what is happening' **IGNORE** ' because that's the way it works' **IGNORE** 'because it is still unproven'
		(iii)	supported by , more evidence / new research / more work ; *idea of* fitting evidence more closely (than lock & key) ;	1 max	**ACCEPT** example, e.g. X-ray crystallography **ACCEPT** e.g. 'it has now been found that the enzyme shape changes during the reaction' **IGNORE** responses in terms of 'because that is how it happens'. Answers must refer to evidence. **ACCEPT** 'in the lock and key model the lock changes rather than the key'

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Question			Answer		Marks	Guidance
	(b)	(i)			3 max	**Mark the first answer on each prompt line.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then **= 0 marks.**
			1	enzyme / LDH , concentration / volume **;**		**1 IGNORE** 'amount / number'
			2	substrate / lactate, concentration / volume **;**		**2 IGNORE** 'amount / number' **2 IGNORE** 'reactants' **1 or 2 CREDIT** 'volume / concentration , of solution' once if no reference to enzyme **or** substrate
			3	time **;**		
			4	*idea that* fish should be as closely related as possible **;**		**4 ACCEPT** e.g. 'same type of fish' **4 IGNORE** size / age / sex
			5	pH **;**		
		(ii)	**L ;**		**1**	**Do not award mark if more than one letter given.** **ACCEPT** lactate and water at all temperatures

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Question			Answer		Marks	Guidance
		(iii)	**1**	(1°C is) below the optimum temperature / optimum temperature is higher , for this enzyme **;**	**2 max**	**1 ACCEPT ‘**optimum is 10°C’ **1 IGNORE** ‘1°C is not the optimum temperature’ **1 ACCEPT** ‘1°C is further away from the optimum (than 10°C)’
			2	(at 1°C) low kinetic energy / KE , of , enzyme / substrate **;**		**2 ACCEPT** ‘molecules’ / ‘particles’
			3	less chance of substrate entering active site / less chance of ESC formation / fewer collisions between substrate and active site **;**		**3 ACCEPT ‘**fewer ESC formed’ **3 ACCEPT** ‘slower ESC formation’ **3 IGNORE** denatured
			4	*idea of* activation energy harder to reach **;**		**4 ACCEPT** ‘activation energy is greater’
		(iv)	easier for / increased chance of , substrate, entering active site **;**		**1**	Answers must imply ‘easier’ or ‘quicker’ **ACCEPT** ‘fitting into’ ‘joining’ ‘binding’ **IGNORE** refs to ‘binding to a larger range of substrates’ **IGNORE** refs to ESC
			more bonds can form / greater surface area for contact (between active site and substrate) **;**			**ACCEPT** ‘different bonds can form’ **ACCEPT** ‘(named) bonds form more easily’
			easier for active site to change shape (as part of induced fit) **;**			**DO NOT CREDIT** if a candidate thinks that flexibility increases kinetic energy
			the induced fit , will be easier / AW **;**			

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Question			Answer	Marks	Guidance
	(c)	(i)	different, amino acids / amino acid sequence / primary structure **;** different, (named feature of) secondary / (named feature of) tertiary / quaternary, structure **;**	**2**	**ACCEPT** 'different R groups present' **ACCEPT** e.g. more α-helices / different or fewer (named) bonds / (different) prosthetic group / co-factor / ion / co-enzyme / R-groups in different orientation / polypeptide OR chain will fold differently **IGNORE** 3D **IGNORE** protein / enzyme , will fold differently
		(ii)	different , base / nucleotide , sequence **;** different , proportion / ratio , of bases / nucleotides **;** different , allele / gene (would code for the polypeptide) **;**	**2**	**IGNORE** 'different gene sequence' **IGNORE** mutation **ACCEPT** different triplet / codon **ACCEPT** 'number of bases / nucleotides' **ACCEPT** 'different numbers of A or T / C or G' **ACCEPT** 'more adenines' etc **ACCEPT** 'mRNA will be different' **IGNORE** chromosome
	(d)	(i)	enzyme could have potential / future , application **;** any example of potential application **;**	**1 max**	**IGNORE** refs to enzyme being useful to the Antarctic fish **IGNORE** genetic resource or any ref to biodiversity **ACCEPT** 'could be of use to humans' eg medical use, low temperature washing powder, scientific research

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Question				Answer	Marks	Guidance
		(ii)	1	ban fishing (in this area / Antarctic) ;	2 max	**1** Answers must refer to banning or legislating (and fishing) **1 IGNORE** 'legislation' unqualified, **1 IGNORE** less fishing unqualified **1 IGNORE** 'ban hunting' unqualified
			2	*idea of* quotas / limits on numbers caught ;		**2 ACCEPT** refs to net / mesh size **2 ACCEPT** idea of patrolling / enforcing
			3	*idea of* protecting (this) habitat (from drilling etc) ;		**3 CREDIT** in terms of maintaining fish's food source **3 IGNORE** 'feeding fish' **3 IGNORE** refs to 'in National Parks' unqualified **3 e.g.** 'protect habitat by banning fishing' = 2 marks (mp1 and mp 3)
			4	*ex situ* (conservation) / captive breeding ;		**4 ACCEPT** 'in captivity' / AW **4 ACCEPT** 'fish farming' **4 ACCEPT** ref to sperm / egg, banks
			5	*idea of* promoting other species (for eating) ;		
			6	educating people in the fishing industry ;		**6 IGNORE** education unqualified
				Total	**18**	

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<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>2</td><td>(a)</td><td></td><td>
<table>
<tr><th>kingdom</th><th>membrane -bound organelles</th><th>cell wall</th><th>type(s) of nutrition</th></tr>
<tr><td></td><td></td><td></td><td>heterotrophic and autotrophic ;</td></tr>
<tr><td>protoctist(s)/ Protoctista ;</td><td></td><td></td><td></td></tr>
<tr><td></td><td>present ;</td><td></td><td></td></tr>
<tr><td>plant(s) / Plantae ;</td><td></td><td>(present and made of) cellulose ;</td><td></td></tr>
<tr><td></td><td>present ;</td><td></td><td></td></tr>
</table>
</td><td>6</td><td>Mark the first answer in each box. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks

IGNORE case of initial ‘P’

ACCEPT ‘✓’ or ‘yes’

IGNORE case of initial ‘P’

ACCEPT ‘✓’ or ‘yes’</td></tr>
<tr><td></td><td>(b)</td><td></td><td>fungi ;</td><td>1</td><td>Mark the first answer. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks

ALLOW fungus / fungal / fungae
IGNORE case of initial ‘f’</td></tr>
</table>

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Question			Answer		Marks	Guidance
	(c)			*Assume answers refer to 3 domain classification unless otherwise stated*	3 max	**CREDIT** Latin forms of domain names throughout **IGNORE** case of initial letter
			1	based on (differences in) , DNA / RNA / nucleic acids / polynucleotides **;**		**1 CREDIT** in the context of an example
			2	*idea that* more accurately reflects origins (of, prokaryotes / eukaryotes) **;**		
			3	(domain) divides / AW , prokaryotes **; ora**		**3** 'prokaryotes are split into groups because bacteria and archaea are different' = 2 marks (mp 3 and 4)
			4	*idea that* domain reflects differences / AW , between (eu)bacteria and archaea **;**		**4 ACCEPT** phonetic spellings of 'archaea' **4 ACCEPT** 'archaebacteria' **4 IGNORE** multiple examples for this mp, must be a general statement
			5	example of two differences to support point 3 or 4 **;**		**5 IGNORE** if mp 3 or 4 not awarded **5** e.g. (differences between) cell wall / cell membrane / flagella / (named) RNA enzymes / ATPase / proteins bound to genetic material / DNA replication / transcription etc
			6	(domain) groups / AW , eukaryotes together **; ora**		**6 IGNORE** as part of a list of domains. Answer must state that eukaryotes have been placed in the same group. **6** 'eukaryotes are placed in the same group because they have similarities' = 2 marks (mp 6 and 7) **6 IGNORE** 'are similar'
			7	*idea that* domain reflects the fact that there are similarities between eukaryotic kingdoms **;**		**7 IGNORE** multiple examples for this mp, must be a general statement
			8	example of two or more similarities to support point 6 or 7 **;**		**8 IGNORE** if mp 6 or 7 not awarded **8** e.g. all eukaryotes have, nuclei / membrane bound organelles / 80S ribosomes / large cell size / linear DNA / chromosomes / histones etc.
				Total	10	

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Question			Answer		Marks	Guidance
3	(a)		1	natural / directional , selection ;	4 max	
			2	mutation ;		2 **DO NOT CREDIT** if implied as a consequence of selection pressure
			3	(mutation / genetic variation, is) random / due to chance / spontaneous / pre-existing ;		
			4	selection pressure is lack of / competition for , food / prey ;		4 **ACCEPT** 'selection pressure is ability to hunt' 4 **ACCEPT** 'selective pressure'
			5	individuals with mutation(s) / allele(s) / gene(s) (for echolocation) , survive ; **ora**		5 **IGNORE** refs to breeding / reproduction 5 **ACCEPT** 'individuals that can echolocate survive' **ora** 5 **DO NOT CREDIT** if answer implies that echolocation is a learned behaviour
			6	(echolocation) allele(s) / gene(s) / mutation(s) , passed on (to next generation) ;		6 **IGNORE** 'genetic trait(s)'
			7	over many generations frequency of , echolocation / allele / characteristic , increases ;		7 Answers must imply multiple generations 7 **ACCEPT** 'over time' as an alternative to 'over many generations' but must be further qualified
	(b)	(i)	*Pipistrellus* ;		1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **IGNORE** case of initial letter 'P' **DO NOT CREDIT** if species name given as well

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Question			Answer		Marks	Guidance
3	(b)	(ii)	similar / same, (body) mass ; similar wingspan ; `similar / same, colour ; all characteristics , similar / same, except echolocation / wingspan ; previously unable to measure echolocation (frequency) ;		1 max	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **IGNORE** 'similar appearance' **ACCEPT** 'both 5.5 g' **IGNORE** 'same' **ACCEPT** 'almost the same' or 'small difference' or ref to figures **ACCEPT** 'both (medium to dark) brown'
	(b)	(iii)	**1** **2** **3** **4**	genetics / genes / DNA ; RNA ; amino acid sequences ; cytochrome C / fibrinopeptide ;	2 max	**Mark the first two answers only.** **1 IGNORE** chromosomes **1 ACCEPT** (named) bases **1 or 2 CREDIT** 'nucleotide sequence / polynucleotide base sequence' for 1 mark if neither of mp 1 nor mp 2 have been awarded **3 ACCEPT** primary structure of polypeptide **4 ACCEPT** haemoglobin

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Question			Answer	Marks	Guidance
3	(b)	(iv)	(inter)breed / AW **;** determine if offspring are fertile **;** if offspring are infertile / no offspring produced, then different species **; ora**	2 max	**ACCEPT** 'mate' / 'reproduce' **CREDIT** 'observe to see if populations are reproductively isolated' as resitting A2 candidate might consider phylogenetic species definition This mark is for assessing the fertility of the offspring 'if they belong to the same species they will be able to breed with each other and produce fertile offspring' = 2 marks (1st and 3rd)

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Question				Answer	Marks	Guidance
3	(c)			***Most marks*** *(apart from **C2**, **C5** and **D5**) are stand alone and do not need to be linked to context. However, **max 5** if any statements are mismatched.*	**6 max**	*For example* ' some variation is controlled by only one gene this variation will have intermediates' **AWARD D2** and **C4** but **max 5** for the whole question and **DO NOT AWARD QWC** and put **CON** in the margin
			C1	continuous ;		
			C2	(continuous / AW , is) effect of , many genes / polygenic / genes and environment / genetic and environmental / environment **;**		**C2 IGNORE** alleles **C2 IGNORE** example of environmental factor, e.g.diet **C2** Must be linked to context of continuous variation
			C3	quantitative **;**		**C3** No ora for discontinuous
			C4	there is a range / any value is possible / intermediate values / no distinct groups / AW **;**		
			C5	*example* to illustrate any C marking point **;**		**C5 must be linked to another C mark** **CREDIT** only , body mass / wingspan / colour / range of pitch within species
			D1	discontinuous ;		
			D2	(effect of) one / few, genes **;**		**D2 ACCEPT** 'there is a gene for pitch' or 'there are high-pitched and low-pitched alleles' **D2 ACCEPT** any suggestion of a low number of genes **D2 IGNORE '**variation is genetic'
			D3	little / no, environmental effect **;**		**D3 ACCEPT** 'only influences by genes' / AW **D3 IGNORE** unqualified refs to genes
			D4	discrete categories / no intermediates / AW **;**		**D4 ACCEPT** 'set groups'
			D5	*example* to illustrate any D marking point **;**		**D5 Must be linked to another D mark** **D5 CREDIT** only these examples: low-pitched or high-pitched / pitch variation between species / sex / no bat call between 47 and 52 Hz **D5 IGNORE** 'colour' as an example to support a D mark

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Question			Answer	Marks	Guidance
3	(c)		**QWC** – Award for successfully relating continuous or discontinuous variation to the effect of genes or environment **;**	**1**	Award if candidates have been awarded **either** **C2 and any other C mark** **or** **D2 / D3 and one of D1, D4 or D5** **DO NOT AWARD QWC** if any mark has been given in the wrong context
			Total	**17**	

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Question			Answer	Marks	Guidance
4	(a)	(i)	polysaccharide **;**	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **ACCEPT** phonetic spelling **IGNORE** polymer **IGNORE** oligosaccharide
		(ii)	*similarity* chain / unbranched / glycosidic bonds / (contain) hexose / hex ring / O in each ring / CHO **;** *difference* *agarose has:* two types of (glycosidic) bond **or** two different, sugars / sugar residues / monosaccharides **or** disaccharide, monomer / subunit / AW **or** (residues) are alternately rotated / AW **or** straight chain **;**	**2**	**IGNORE** polysaccharides **IGNORE** 6-carbon ring **ACCEPT** 5-carbon ring Assume answer refers to agarose unless otherwise stated **ACCEPT** ora for any point **DO NOT CREDIT** references to any incorrect bond **ACCEPT** any suggestion of bonding to different numbered carbon atoms (as numbers are not given in diagram) **ACCEPT** 'alternating bonds' **IGNORE** refs to glucose **ACCEPT** 'flipped' / 'reflected' **ACCEPT** 'amylose is coiled'

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Question			Answer	Marks	Guidance
4	(b)		(bacteria) do not, make / have, correct <u>enzyme</u> (to digest agarose) **;** agarose, does not fit / not complementary to, <u>active site</u> (of bacterial enzymes) **;** bacteria unable to transport **,** substrate / enzyme , across membrane **;**	**1 max**	**DO NOT CREDIT** in incorrect context e.g. 'bacteria do not have amylase' or 'bacterial enzyme cannot break down amylose'
	(c)	(i)	<u>control</u> **;** compare with tube A / see what happened when there was no bacteria / show it was bacteria doing it / to show it does not break down on its own / to show that the nutrient solution does not break it down **;**	**2**	**ACCEPT** 'compare it with the other tube' **IGNORE** 'compare the tubes'

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Question			Answer	Marks	Guidance
4	(c)	(ii)	*idea that* some, starch / other polysaccharide / (reducing) sugar present in , nutrient solution / culture solution / bacteria (at start) **;** presence of some mutated , *E. coli* / bacteria , (that can break it down) **;** presence of (other) microorganism that can break it down **;**	**1 max**	**IGNORE** experimental error unqualified **IGNORE** any reference to temperature **IGNORE** other carbohydrate
		(iii)	replicate(s) / repeat(s) **;** more than one sample tested from each tube / sample each tube twice **;**	**2**	**Mark the first answer on each prompt line.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **IGNORE** 'do more tests' **IGNORE** 'disregard anomalous results' **IGNORE** 'compare with other results' **IGNORE** 'calculate mean'

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Question			Answer		Marks	Guidance
4	(d)	(i)	**1**	add, Benedict's (reagent) / $CuSO_4$ + NaOH / alkaline copper sulphate **;**	**5 max**	**1 ACCEPT** 'do Benedict's test' **1 DO NOT CREDIT** if adding acid / hydrolysing
			2	heat **;**		**2 ALLOW** boil **2 IGNORE** warm **2 ACCEPT** any temperature between 80°C and 100°C **2 ACCEPT** gently heat
			3	(forms) <u>precipitate</u> **;**		
			4	(colour changes from blue to), green / yellow / orange / brown / (brick) red **;**		
				concentration estimated from		Read as prose and mark the best suggestions
				EITHER		**5/6 DO NOT AWARD** if candidate is using a colorimeter
			5a	degree of colour change / use different colours **;**		**5a ACCEPT** 'the darker / redder , the more reducing sugar' **5a ACCEPT** in context of precipitate or supernatant
			6a	comparison (of final colour) with , standard / known, solution **;**		**6a** Answers must include the idea of comparison **6a ACCEPT** ref to calibration curve as long as not in context of colorimeter
				OR		
			5b	filter / centrifuge , **and** weigh precipitate **;**		
			6b	greater mass = more sugar present / use of a standard curve **;**		**6b ACCEPT** weight **6b ACCEPT** amount
				OR		
			5c	centrifuge **;**		
			6c	size **,** of pellet / colour of supernatant (liquid), indicates concentration **;**		**6c ACCEPT** mass

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Question			Answer		Marks	Guidance
		(ii)			3 max	*Max 2 if any point out of sequence*
			1	add (hydrochloric) acid and boil **;**		**1 CREDIT** add hydrolytic enzyme **1 ACCEPT** heat
			2	add, (named) alkali / (sodium) carbonate / (sodium) hydrogencarbonate **;**		**2 CREDIT** 'neutralise' if not contradicted by named chemical
			3	then carry out reducing sugar test (again) / described **;**		
				Total	**17**	

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Question			Answer	Marks	Guidance
5	(a)	(i)	11.3 **; ;**	2	**Correct answer = 2 marks** even if no working shown. **IGNORE** '-' before the number If the answer is incorrect, **ALLOW** 1 mark for seeing $\frac{(2.75 - 2.44)}{2.75} \times 100$ **or** $\frac{0.31}{2.75} \times 100$ If the answer is not given to 1 decimal place, **ALLOW** 1 mark for A correct but unrounded answer (11.2727…, 11.27˙ etc) **or** A correct answer that has been rounded to the wrong number or decimal places **or** A correct answer seen but has been rounded incorrectly (eg 11.2)

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Question				Answer	Marks	Guidance
5	(a)	(ii)			4 max	**ACCEPT** curve / lung function / amount of exhaled air , as AW for FEV
			1	non-smokers' FEV higher than smokers' **; ora**		**1 DO NOT CREDIT** FEV is higher **at the start** (alone) as this implies it is lower later on
			2	smokers' FEV , declines / falls / drops / decreases (over time) **;**		**2 IGNORE** 'both decline'
			3	widening gap (between smokers and non-smokers) / rate of decline is lower in non-smokers / smaller reduction in non-smokers **;**		**3 ACCEPT** ora for decline and extent of reduction
			4	non smokers' (FEV) increases then decreases / peaks **;**		
			5	non-smokers' (curve / FEV / lung function) has peak at 1.5 years **and** 2.88 dm^3 **;**		
			6	appropriate figures to support mp 1 - 3 **;**		**6** Figures must include 2 FEVs with units linked to time in years and must support the point being made. **6 ALLOW** valid calculated comparison **6 ALLOW** comparative dates such as '2 years later'

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Time (years)	FEV_1 (dm^3) had stopped smoking	FEV_1 (dm^3) continue to smoke	Acceptable range for difference	Other useful figures:
0.0	2.82	2.75	0.07	Increase over 1 ½ years for stopped smoking = 0.06 dm^3 Decrease over 1 ½ years for continue to smoke = 0.06 – 0.07 dm^3 Decrease over from 1 ½ years to 5 years for stopped smoking = 0.10 – 0.11 dm^3 Decrease over from 1 ½ years to 5 years for continue to smoke = 0.24 – 0.25 dm^3 Decrease over 5 years for stopped smoking = 0.04 – 0.05 dm^3 Decrease over 5 years for continuing smokers = 0.31 dm^3
0.5	2.85	2.73	0.12	
1.0	2.87	2.71	0.16	
1.5	2.88	2.68 – 2.69	0.19 – 0.20	
2.0	2.87	2.67 – 2.68	0.19 – 0.20	
2.5	2.86	2.64	0.22	
3.0	2.84	2.60	0.24	
3.5	2.82 – 2.83	2.56 – 2.57	0.25 – 0.27	
4.0	2.80	2.53	0.27	
4.5	2.78 – 2.79	2.49	0.29 – 0.30	
5.0	2.77 – 2.78	2.44	0.33 – 0.34	

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Question			Answer		Marks	Guidance
5	(b)	(i)		*causes*	6 max	
			1	tar ;		
			2	(cigarette smoke) destroys / damages / paralyses, cilia / ciliated epithelium ;		2 **ALLOW** in response to any component of cigarette smoke 2 **DO NOT CREDIT** 'kills cilia' / 'cilia die' 2 **IGNORE** 'cilia stick together'
			3	(cigarette smoke stimulates) goblet cells to release more mucus ;		3 **ALLOW** in response to any component of cigarette smoke 3 Must contain the idea of more mucus than normal
			4	mucus (in airways) , builds up / cannot be removed / AW ;		
			5	more, pathogens / bacteria / viruses / microbes, collect / trapped / accumulate (in mucus) ;		5 **IGNORE** 'pathogens' alone must have idea of increasing number of pathogens e.g. **ACCEPT** 'breeding' 'multiplying' /AW 5 **ACCEPT** 'higher number of pathogens present' 5 **ACCEPT** 'infections more likely'
			6	*idea that* cough is an attempt to , increase air flow / remove microbes , by removing mucus ;		6 There must be a reason for removing the mucus 6 **ACCEPT** 'to clear the throat by removing mucus' 6 **ACCEPT** 'to reduce infections by removing mucus'
				effects		
			7	(frequent coughing) damages / inflames, (named) airway / alveoli / elastic fibres ;		7 **IGNORE** damage to lungs 7 **IGNORE** damage as a result of elastase / emphysema
			8	formation of scar tissue ;		8 **CREDIT** in any part of lung
			9	airway / bronchi / bronchiole, walls thicken ;		9 **IGNORE** 'trachea' 9 **CREDIT** 'smooth muscle (in wall) thickens'
			10	lumen of , airway / bronchi / bronchiole , narrows ;		10 **IGNORE** 'trachea'
			11	flow of air restricted ;		11 'airflow restricted due to extra smooth muscle' = 2 marks, mp 9 and 11
			12	(damage to alveoli causes) reduced surface area for , gas exchange / oxygen diffusion ;		
			QWC – One cause of cough and one effect of cough		1	**Award** if at least 1 mark has been given from each of the mark scheme sections (1-6 and 7-**11**) for this question.

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Question			Answer		Marks	Guidance
5	(b)	(ii)	emphysema ; chronic bronchitis ; asthma ;		2 max	**Mark the first answer on each prompt line.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **ACCEPT** phonetic spellings **IGNORE** emphysemia
		(iii)	**1**	elastin is substrate ;	5 max	**1** Must be a clear statement
			2	(elastin / substrate) binds to / fits into , active site ;		**2 IGNORE** complementary **2 ACCEPT** goes in to
			3	active site / enzyme / elastase / substrate / elastin, shape changes ;		**3/4 CREDIT** 'mould around' once for either mp 3 or mp 4 but award the alternate marking point if seen
			4	*idea of* closer fit (between active site and substrate) ;		**4 ACCEPT** eg tighter / more precisely / in a better position
			5	more bonds form (between substrate and active site) ;		**5 ACCEPT** 'interactions'
			6	forms enzyme-substrate-complex / ESC ;		
			7	*idea that* (change in shape of active site) destabilises / weakens , bonds (in substrate) / substrate ;		**7 ACCEPT** e.g. puts, pressure / strains, on
			8	activation energy reduced ;		
			9	*idea of* further shape change of, active site / enzyme, after products form ;		**9 IGNORE** 'the enzyme is unchanged'
				Total	20	

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Question			Answer		Marks	Guidance
6	(a)	(i)	1	<u>artificial selection</u> / <u>selective breed</u>ing ;	3 max	
			2	select (male and female) sheep that are, larger / woollier / meatier/ have desired characteristics ;		**2 ACCEPT** 'large / woolly / meaty, male and female that can produce healthy offspring' ; **2** 'sheep' can be inferred from 'individuals' as it is in the stem of the question
			3	crossbreed / breed (together) / mate (together) / interbreed ;		**3 ACCEPT** 'reproduce'
			4	select , best / AW, offspring ;		
			5	*idea of* breeding (and selecting) for , many / several , generations ;		**5 IGNORE** traits passed on through generations, answers must imply breeding and selection
		(ii)		(use of) (named) antibiotics ; (use of) (named) pesticides / insecticides / fungicides ; cloning / genetic modification / AW ; artificial insemination / AI / IVF / marker-assisted selection ; hormones ; vaccinations ;	1 max	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **IGNORE** refs to 'fertiliser' etc., as 'sheep' is in question stem **IGNORE** refs to diet **ACCEPT** 'steroids' / 'growth supplements' **IGNORE** 'better veterinary care'

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Question			Answer		Marks	Guidance
6	(b)	(i)	1	broken down by, decomposers / bacteria / fungi ;	3 max	
			2	add (named) mineral(s) to soil ;		2 **IGNORE** nutrients **ACCEPT** ions
			3	nitrate and phosphate and potassium / NPK ;		3 **ACCEPT** nitrogen , $NO_3^{(-)}$, $PO_4^{(3-)}$, $K^{(+)}$ NH_3, $NH_4^{(+)}$, ammonium, ammonia 3 **IGNORE** phosphorous, P , N_2
			4	specific use of (any) named mineral ;		4 eg nitrate or nitrogen for protein, magnesium for chlorophyll, etc. 4 **DO NOT CREDIT** vague uses like 'nitrate for growth'
			5	lack of (named) , mineral(s) / nutrient(s) / ion(s), is limiting factor (for growth) ;		
			6	*example of* way in which soil quality is improved ;		6 **ACCEPT** for example change in pH / crumb size / air content / moisture content / less leaching of minerals / increased humus / presence of (named) detritivores / less risk of soil erosion

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Question			Answer		Marks	Guidance
6	(b)	(ii)	1	(fertiliser) promotes growth of, one / few, (plant) species ;	2 max	1 **ACCEPT** 'once species might grow more than another' 1 **IGNORE** 'yield'
			2	other (plant) species , out-competed / AW (as a result of competition from crop species) ;		2 **IGNORE** fertilisers / eutrophication , killing other plants 2 **ACCEPT** 'other plants die' in the context of their being out-competed by the crop plant
			3	*idea of* disruption of food chains ;		3 **DO NOT CREDIT** in the context of biomagnification / eutrophication
			4	*idea of* reduction in , soil quality / humus , over time so plants cannot grow ;		4 **ACCEPT** 'might change soil pH so some plants can't grow'
		(iii)			3 max	**IGNORE** answers in the context of genetic variation **within the domestic population**. For example,' if one plant is susceptible to a disease then they might not all die'.
			1	loss of genetic , diversity / variation (in wild population) ;		1 **ACCEPT** small / reduced , gene pool
			2	environment / agricultural requirements, may change (in future) ;		
			3	(lost) genes / alleles , may have been useful ;		3 **ACCEPT** 'potential genetic resource may have been lost'
			4	e.g. of gene useful to agriculture ;		4 *e.g., gene for* pest resistance / disease resistance / heat tolerance / drought tolerance ; 4 **DO NOT CREDIT** immunity to diseases
			5	fewer pollinators ;		
			6	loss of (pest) predators ;		
				Total	12	

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<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>7</td><td></td><td></td><td>
<table>
<tr><th>definition</th><th>term</th></tr>
<tr><td>sampling in which the observer does not decide when and where to take measurements</td><td>random ;</td></tr>
<tr><td>a representative group of organisms that are selected from a population</td><td>sample ;</td></tr>
<tr><td>the area in which an organism lives</td><td>habitat ;</td></tr>
<tr><td>a measure of the relative numbers of individuals in each species</td><td>species evenness ;</td></tr>
<tr><td>the frequency of occurrence of plants in a particular area</td><td>abundance ;</td></tr>
<tr><td>the number of species present in a particular area</td><td>species richness ;</td></tr>
</table>
</td><td>6</td><td>DO NOT AWARD mark if two or more answers are given in any box except IGNOREs listed below

IGNORE systematic

IGNORE percentage cover

IGNORE biodiversity</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>6</td><td></td></tr>
</table>

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Wednesday 18 January 2012 – Afternoon

AS GCE BIOLOGY

F212 Molecules, Biodiversity, Food and Health

Candidates answer on the Question Paper.

OCR supplied materials:
- Insert (inserted)

Other materials required:
- Electronic calculator
- Ruler (cm/mm)

Duration: 1 hour 45 minutes

F2100301111

F 2 1 2

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- The Insert will be found in the centre of this document.
- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined pages at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **100**.
-  Where you see this icon you will be awarded marks for the quality of written communication in your answer.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.
- This document consists of **24** pages. Any blank pages are indicated.

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Answer **all** the questions.

1 Biological molecules are held together by a variety of bonds.

(a) The diagram in Fig. 1.1 represents an amino acid.

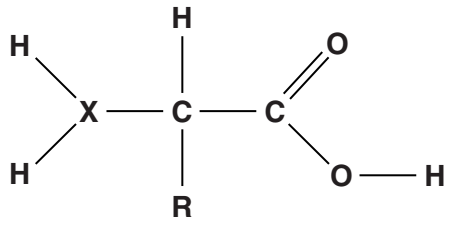


Fig. 1.1

(i) One of the atoms that make up an amino acid has been replaced with the letter **X**.

State the chemical symbol of the atom represented by the letter **X** in Fig. 1.1.

..... **[1]**

(ii) Name the polymer formed from a chain of amino acids.

..... **[1]**

(iii) Name the bond that is formed when two amino acids are joined together. Describe the formation of this bond.

name of bond .....

description of formation

.....

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..... **[3]**

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(b) Fig. 1.2 shows a hydrogen bond between two water molecules.

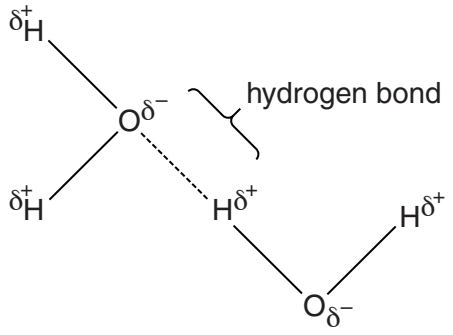


Fig. 1.2

(i) Many of the physical properties of water arise as a result of these hydrogen bonds.

Describe ways in which the physical properties of water allow organisms to survive over a range of temperatures.

In your answer you should make clear links between the properties of water and the survival of organisms.

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..... **[9]**

(ii) List **three other** examples of where hydrogen bonds are found in biological molecules.

1 .....

2 .....

3 ..... **[3]**

[Total: 17]

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2 Malaria is a disease caused by a eukaryotic parasite.

(a) State **two** features of the malarial parasite that indicate that it is **not** a prokaryote.

1 .....

2 ..... **[2]**

(b) In a piece of word-processed homework, a student stated that one species of parasite that causes malaria is called:

Plasmodium Vivax

State **one** error made by the student.

.....

..... **[1]**

(c) The malarial parasite is carried by an insect, the female *Anopheles* mosquito.

(i) Describe how the mosquito transmits the malarial parasite to a human.

.....

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..... **[3]**

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(ii) In order to fight the spread of malaria, insecticides have been used in areas where the *Anopheles* mosquito breeds.

One problem that can occur when using insecticides in this way is the development of insecticide resistance.

Suggest **one other** reason why some people might be concerned about using insecticides.

.....

.....

..... **[1]**

(iii) Suggest how the effects of insecticide use on a population of *Anopheles* mosquitoes could be measured **and** state the steps that should be taken in order to produce valid and reliable results.

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..... **[5]**

[Total: 12]

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3 Cholesterol is an important biological molecule.

(a) State **two** roles of cholesterol in living organisms.

1 .....

.....

2 .....

..... **[2]**

(b) Fig. 3.1 represents the structure of a cholesterol molecule.

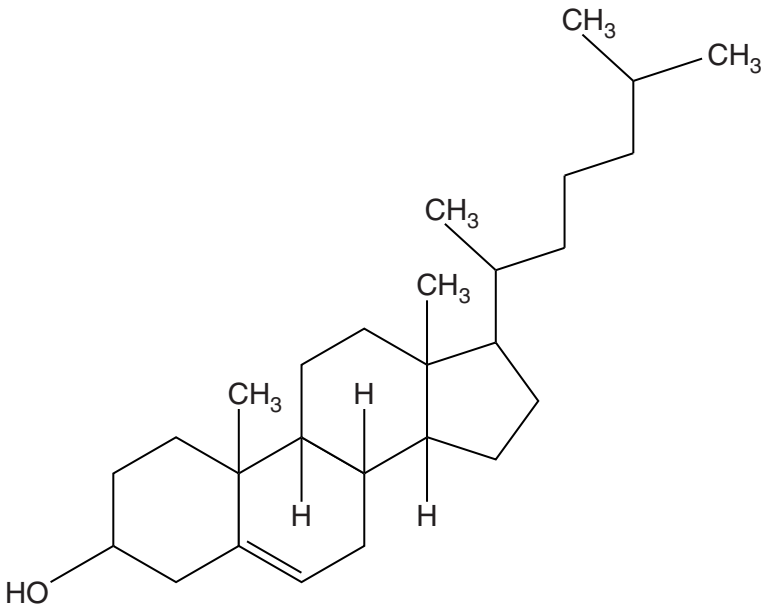


Fig. 3.1

(i) Identify **one** way in which the molecular structure of cholesterol is similar to the molecular structure of a carbohydrate.

..... **[1]**

(ii) Cholesterol is transported in the blood within molecules of low-density lipoprotein (LDL).

Name **two** molecules that combine with cholesterol to form LDLs.

.....

..... **[2]**

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(iii) LDL and a similar molecule, high-density lipoprotein (HDL), carry cholesterol in the blood. LDL and HDL affect the formation of atheromas in the arteries.

Describe the different ways in which LDLs and HDLs affect the formation of atheromas.



In your answer you should make clear the differences in the involvement of LDL and HDL in the formation of atheromas.

..... **[7]**

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(c) (i) In countries such as the UK, in which red meat forms a large part of the diet, people tend to have high levels of blood cholesterol compared with people in countries in which little red meat is eaten.

Suggest why diets with a high red meat content are associated with high blood cholesterol.

.....

.....

.....

.....

..... **[2]**

(ii) Name a disease, other than atherosclerosis, for which high blood cholesterol is a risk factor.

..... **[1]**

[Total: 15]

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QUESTION 4 STARTS ON PAGE 12

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4 The system used by scientists for classifying living things has developed from the original classification system proposed by Carl Linnaeus around 250 years ago.

(a) Complete the following paragraph by using the most appropriate term(s).

The system of classifying organisms according to their observable features or genetic characteristics is called ..... . Organisms are classified into large groups which are then subdivided into increasingly smaller groups. A system such as this is called a ..... . The term that describes the evolutionary relationship between organisms is ..... .

[3]

(b) New Zealand is made up of two large and many smaller islands and is situated a long distance from any other land mass.

In New Zealand there is a large variety of birds not found elsewhere in the world.

Among its many species of the parrot family, Psittacidae, are:

- kaka (*Nestor meridionalis*)
- kea (*Nestor notabilis*)
- kakapo (*Strigops habroptila*)

These birds are shown in Fig. 4.1 **on the insert**.

(i) State **two** characteristics that birds, such as parrots, share with other members of the animal kingdom.

1 .....

2 ..... **[2]**

(ii) Name the **domain** to which the parrot belongs.

..... **[1]**

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(iii) Species that are more closely related in evolutionary terms have more genes in common than species that are less closely related.

Using the information provided, suggest the likely genetic relationship between the three parrot species.

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..... **[4]**

QUESTION 4 CONTINUES ON PAGE 14

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(c) The kakapo is one of the world's largest and rarest parrot species. The variation in mass of adult birds in the kakapo population has been reported to be between 950 g and 4000 g.

(i) Define the term *variation*.

.....

.....

.....

..... **[2]**

(ii) Suggest **two** reasons why the kakapo varies in size.

1 .....

2 ..... **[2]**

(iii) Suggest **two** reasons why the reported mass range for the adult kakapo may not be accurate.

1 .....

.....

2 .....

..... **[2]**

(d) At some point in the past, distinct species of New Zealand parrot are likely to have arisen from an original ancestral population.

State the name of the process by which new species arise **and** suggest the mechanisms necessary for this process to occur.

name of process .....

mechanisms necessary for this process to occur .....

.....

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..... **[3]**

[Total: 19]

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QUESTION 5 STARTS ON PAGE 16

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5 **(a)** The black poplar was once a common tree throughout southern Britain. Its numbers have decreased by 94% since 1942 and it is in danger of becoming extinct in the wild.

There are thought to be approximately 2500 black poplars surviving in Britain today.

Use the information above to calculate the original number of black poplar trees in 1942.

Show your working.

Answer = ... **[2]**

(b) Species such as the black poplar contribute to the biodiversity of the UK.

Suggest **three** reasons why the conservation of the black poplar is important.

1 .....

.....

2 .....

.....

3 .....

..... **[3]**

(c) Botanic gardens are important in the conservation of plant species.

(i) State why the conservation of a species in a botanic garden is described as *ex situ*.

.....

..... **[1]**

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(ii) Many botanic gardens use seed banks as a method of plant conservation.

Outline the **advantages** of using a seed bank, as opposed to adult plants, in order to conserve an endangered plant species.

.....

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..... **[4]**

(iii) Suggest why it is important to ensure that, for each species, the seeds in a seed bank have been collected from several different sites in the wild.

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..... **[3]**

[Total: 13]

QUESTION 6 STARTS ON PAGE 18

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6 **(a)** In his book 'On the Origin of Species', Charles Darwin made the following four observations:

W Offspring generally appear similar to their parents.
X No two individuals are identical.
Y Organisms have the ability to produce large numbers of offspring.
Z Populations in nature tend to remain relatively stable.

From these observations he made a number of deductions, which are listed below in Table 6.1.

The deductions are supported by one **or more** of the observations (**W**, **X**, **Y** or **Z**).

In Table 6.1, indicate which of the above observations supported each deduction.

You may use each letter (**W**, **X**, **Y**, or **Z**) once, more than once or not at all.

Table 6.1

deduction	supporting observation(s)
characteristics are passed on to the next generation	
there is a struggle for existence	
individuals with beneficial characteristics are among the few who survive	

[3]

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(b) Resistance to antibiotics has evolved in some pathogenic bacteria, such as MRSA.

Suggest why the resistance of MRSA to existing antibiotics is of major concern to humans.

.....

.....

.....

.....

..... **[2]**

(c) The evolution of antibiotic resistance in bacteria is evidence to support the theory of evolution.

How does **fossil** evidence support the idea that evolution has taken place?

.....

.....

.....

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.....

.....

.....

.....

..... **[3]**

[Total: 8]

QUESTION 7 STARTS ON PAGE 20

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7 **(a)** Lymphocytes are important components of the immune system and can be classified into B lymphocytes and T lymphocytes.

For each of the statements in the table below, identify whether the description applies to:

- only B lymphocytes
- only T lymphocytes
- both B and T lymphocytes
- neither.

You may use each response once, more than once, or not at all. The first one has been done for you.

statement	can be applied to ...
form part of immune response	*both*
matured in thymus	
secrete substances which kill infected cells	
manufacture antibodies	
undergo clonal expansion	
activate other lymphocytes	

[5]

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(b) Fig. 7.1 shows the concentration of antibodies in a patient's blood following an initial infection with a pathogen. This is known as the primary response.

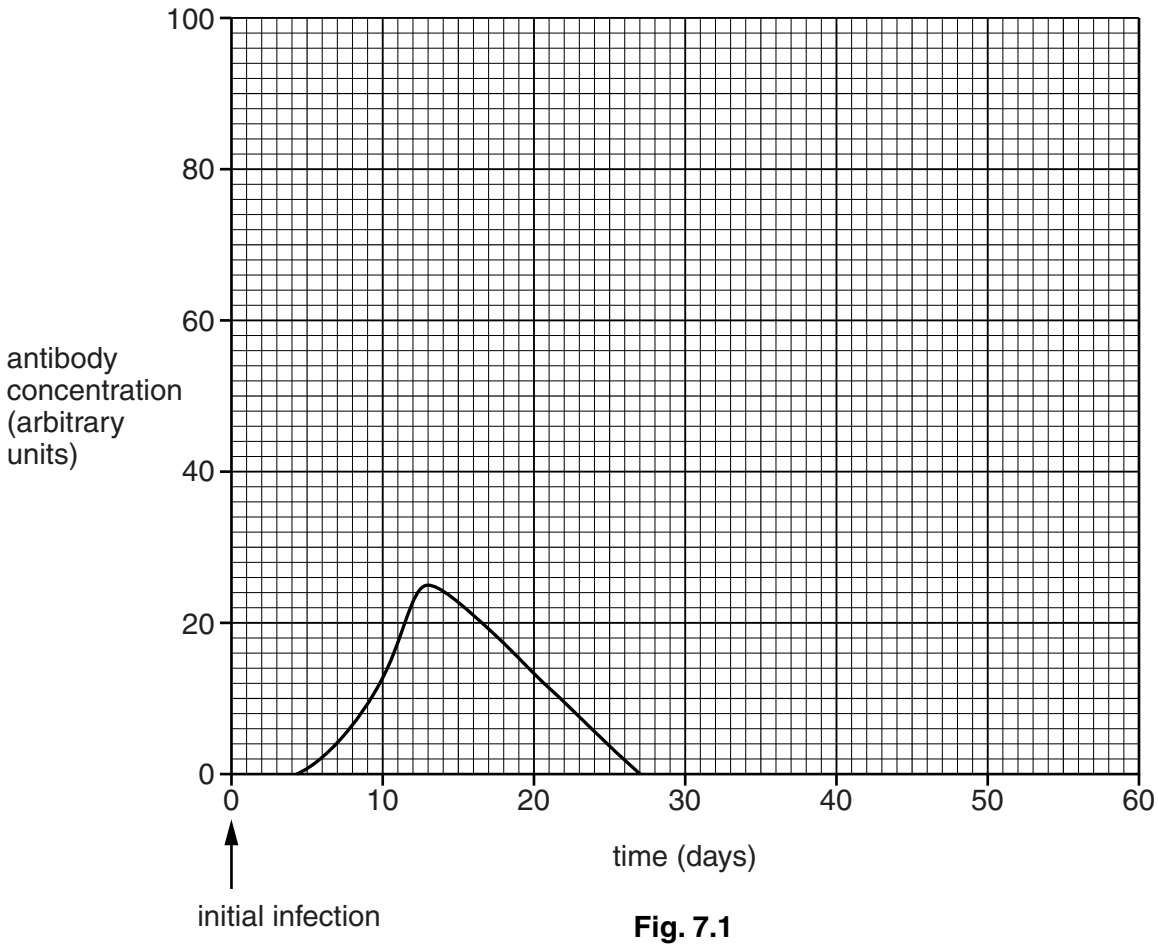


Fig. 7.1

(i) Describe the changes in antibody concentration that occur in the patient's blood during the primary response.

.....

.....

.....

.....

..... **[3]**

(ii) The patient was subsequently infected with the same pathogen 30 days after the initial infection.

Draw a line **on the graph** to show the likely concentration of antibodies in the patient's blood from 30 days onwards.

..... *The answer to this question must be drawn on Fig. 7.1* ..... **[2]**

QUESTION 7(c) STARTS ON PAGE 22

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(c) Fig. 7.2 shows the structure of an antibody.

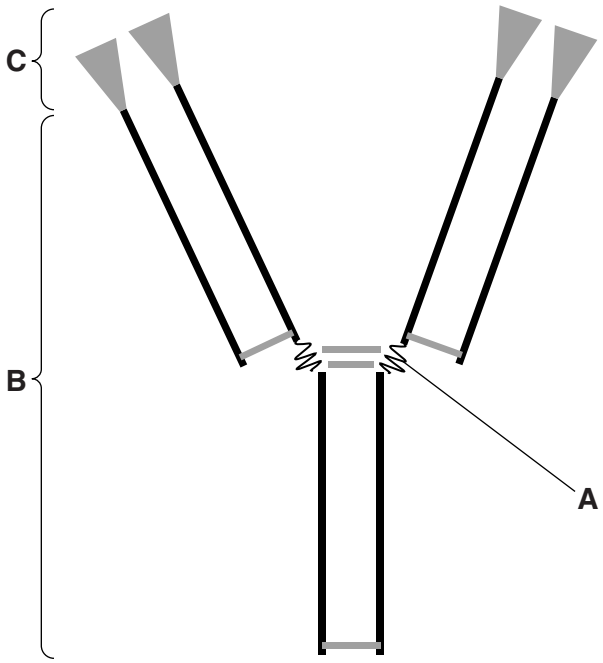


Fig. 7.2

Complete the table below by stating the name and function of each of the regions **A**, **B** and **C**.

region	name	function
A		
B		
C		

[6]

[Total: 16]

END OF QUESTION PAPER

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ADDITIONAL PAGE

If additional space is required, you should use the lined pages below. The question number(s) must be clearly shown.

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ADDITIONAL PAGE

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GCE

Biology

Advanced Subsidiary GCE

Unit **F212:** Molecules, Biodiversity, Food and Health

Mark Scheme for January 2012

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Annotations

Annotation	Meaning
	Correct answer
	Incorrect response
	Benefit of Doubt
	Not Benefit of Doubt
	Error Carried Forward
	Given mark
	Underline (for ambiguous/contradictory wording)
	Omission mark
	Ignore
	Correct response (for a QWC question)
	QWC* mark awarded

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Question			Answer	Marks	Guidance
1	(a)	(i)	N ;	1	**IGNORE** nitrogen **DO NOT CREDIT** n or N_2
1	(a)	(ii)	polypeptide / protein ;	1	**Mark the first answer**. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **IGNORE** peptide
1	(a)	(iii)	*name* peptide (bond / link) ; ***plus any two from ...*** *description of formation* between, amine group (of one amino acid) and carboxyl group (of another) ; H (from amine) combines with OH (from carboxyl) ; condensation (reaction) **OR** water, lost / eliminated / produced / created / AW ;	3 max	Maximum two marks for description. Name must be given to award 3 marks. **ACCEPT** marking points from diagram where amine and carboxyl groups are clearly labelled. **Mark writing first then look at diagram**. If diagram contradicts creditable text award maximum one mark for description. **DO NOT CREDIT** dipeptide **ACCEPT** phonetic spellings of amine and carboxyl **ACCEPT** 'carboxylic acid' and 'amino' **DO NOT CREDIT** amide / carbonyl

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Question			Answer	Marks	Guidance
1	(b)	(i)		8 max	Annotate property (number 1) marks with ✓ **1** symbol to help distinguish marks for QWC All marks are stand alone
			V1 high latent heat of vaporisation / large amount of energy required to change from liquid to gas / AW **;**		**V1 ACCEPT** 'large amount of heat needed…" **V1 ACCEPT** 'high latent heat of evaporation'
			V2 evaporation is (efficient) cooling mechanism / AW **;**		**V2 ACCEPT** 'evaporation removes heat from body'
			V3 example of cooling in living organism **;**		**V3** e.g. sweating, panting, transpiration (as cooling) 'high latent heat of evaporation means sweat cools you down' = 3 marks
			H1 high specific heat capacity / large amount of energy needed to, raise / change, temperature **;**		**H1 ACCEPT** 'water / it, is thermally stable' **H1 ACCEPT** 'water is slow to change temperature' **H1 CREDIT** 'the temperature of the sea does not change much'
			H2 (thermally) stable environment for, aquatic / named aquatic, organisms **;**		**H2** 'thermally' can be inferred from previous statement
			H3 (aquatic) organisms use less energy on temperature control **;**		
			H4 (internal) temperature of organisms changes only slowly **;**		
			H5 (biological) reactions / enzymes / metabolism, function(s) correctly **;**		**H5 IGNORE** 'organisms function correctly'
			F1 ice, is less dense than water / floats **;**		**F1 ACCEPT** 'maximum density is at 4°C'
			F2 (surface of) ice provides habitat for, organisms / named organism **;**		**F2** e.g. 'polar bears on ice'

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Question			Answer	Marks	Guidance
			I1 water (beneath ice), insulated / remains liquid / doesn't freeze **;**		
			I2 (aquatic) organisms, do not freeze / can still swim **;**		**I2 IGNORE** unqualified references to survival **I2 ACCEPT** gametes / AW, can be dispersed
			S1 (effective) solvent **;**		
			S2 medium for reactions / (internal) transport medium / able to dilute toxic substances **;**		
			C1 cohesion / adhesion **;**		
			C2 example of cohesion / adhesion, in living organism **;**		**C2** e.g. transpiration stream / apoplast movement **C2 ACCEPT** descriptions
			T1 surface tension **;**		
			T2 habitat for (named) invertebrates **;**		**T2 ACCEPT** insects **IGNORE** animals
			P1 transparent **;**		
			P2 allows underwater photosynthesis **;**		**P2 ACCEPT** other example of transparency linked to survival, e.g. eyes
			D1 idea of high density **;**		**D1 IGNORE** references to viscosity
			D2 allows flotation / support **;**		
			U organisms can still obtain, oxygen / (named) minerals / food / carbon dioxide, from water **;**		**U** not linked to a single property and so cannot contribute to **QWC** **U IGNORE** nutrients / nutrition

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Question			Answer	Marks	Guidance
			QWC: a property mark (with number 1) and a survival mark with the same letter seen twice.	1	e.g. H1 and H3 **and** S1 and S2

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Question			Answer		Marks	Guidance
1	(b)	(ii)			3 max	**Mark the first answer on each prompt line.**
			1	protein <u>secondary</u> structure / α-helix / β-pleated sheet **;**		
			2	(protein) <u>tertiary</u> structure **;**		
			3	between polypeptide chains in (named) quaternary structure **;**		**3** e.g. between adjacent chains in collagen **CREDIT** 'protein / named protein / enzyme' OR 'between amino acid R-groups' once **ONLY if <u>none</u> of mps 1-3 have been awarded**
			4	(between chains of) cellulose **;**		**4 IGNORE** macrofibrils
			5	(between, strands of / bases in) DNA **;**		
			6	AVP **; ; ;**		**6** e.g. between mRNA and tRNA binding between enzyme and substrate (coiling of) amylose between DNA and mRNA during transcription
				Total	**17**	

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Question			Answer		Marks	Guidance
2	(a)				2 max	**Mark the first answer on each prompt line.** **ACCEPT** ora throughout
			1	nucleus / nuclei **;**		**1 ACCEPT** 'DNA not free'
			2	other named organelle / membrane bound organelles **;**		**2** e.g. mitochondria / Golgi / etc **2 ACCEPT** compartmentalized organelles **2 ACCEPT** don't have a mesosome
			3	linear chromosomes **;**		
			4	DNA, associated with / AW, histones / protein **;**		**4 ACCEPT** 'DNA not naked'
			5	80S / 22nm / large, ribosomes **;**		
			6	large cells / AW **;**		
			7	no cell wall **;**		
2	(b)		capital letter on, specific name / Vivax **;** not italicised / not underlined **;**		1 max	**Mark the first answer** **ACCEPT** ora for what student should have typed **ACCEPT** 'the parasite is Plasmodium falciparum / malariae / ovale' if candidate uses capital 'P' and lower case 'f / m / o'
2	(c)	(i)			3 max	**IGNORE** references to stages of life-cycle **Max 2 if virus / bacterium appears anywhere**
			1	(mosquito), is <u>vector</u> **;**		
			2	*Plasmodium* / parasite, present in (mosquito), saliva / salivary gland **;**		
			3	*idea that* infected mosquito, feeds on / bites, human **;**		**3 IGNORE** case of initial 'P' **3** Must be in context of transmission from mosquito **to** human
			4	*Plasmodium* / parasite, passes (from saliva) to blood **;**		**4** 'blood' can be inferred, e.g. from refs to anticoagulant **4 IGNORE** ref to parasite in blood after liver

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Question			Answer	Marks	Guidance
2	(c)	(ii)	destruction of a species is, morally / ethically, wrong **;** might cause unintended health problems in humans **;** might harm, other / unintended, species **;** *idea of* bioaccumulation / biomagnification **;**	1 max	**Mark the first suggestion** **IGNORE** 'might enter human food' unqualified Answers must imply idea of harm

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Question			Answer		Marks	Guidance
2	(c)	(iii)			5 max	Award marks for either a field or laboratory investigation – **must read whole answer before beginning to mark to decide if field or laboratory.** If candidates answer in terms of incidence of malaria award no marks as question states population of mosquitoes but read whole question in case mosquito study described in addition. If the investigation is in the both field and laboratory mark the investigation which gives candidate most marks.
				Field investigation		
			F1	(sampling) before and after insecticide treatment **;**		**F1 IGNORE** refs to treated and untreated areas as stem refers to 'a population'
			F2	*idea of* , unbiased / random, sampling of population **;**		
			F3	example of sampling technique **;**		**F3** e.g. sweep net, pond net, light trap **F3 ACCEPT** insect net **F3 IGNORE** 'net' **or** 'trap' unqualified
			F4	(sampling in) different, times / weather **;**		**F4 IGNORE** intervals unqualified. Answers must refer to time or weather
			F5	large number of samples taken **;**		**F5** Must imply large number or state five or more
			F6	*idea of* standardised sampling procedure **;**		**F6 ACCEPT** idea of counting by the same method
			F7	*idea of* preventing counting same individual more than once **;**		
			F8	*idea of* capture – recapture **;**		
			F9	calculate mean / calculate standard deviation / apply statistical test **;**		

Continued……..

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Question			Answer		Marks	Guidance
				OR		
				Laboratory investigation		Laboratory investigation could be done outside
				idea of:		
			L1	with and without insecticide exposure **;**		**L1** is for changing the independent variable
			L2	measuring mosquito survival / count surviving mosquitoes **;**		**L2** is for measuring the dependent variable **ACCEPT** count the number of dead ones
			L3	controlling one named key variable **;**		**L3 and L4** *award up to 2 marks for* exposure time species of mosquito stage of mosquito life cycle sex of mosquito number of mosquitos insecticide type insecticide concentration volume of insecticide temperature
			L4	controlling second named key variable **;**		
			L5	*idea of* using a range of insecticide concentrations **;**		
			L6	replicates **;**		**L6** Minimum of 3 in total, i.e. original plus two
			L7	calculate mean / calculate standard deviation / apply statistical test **;**		**L7 IGNORE** average
				Total	**12**	

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Question			Answer	Marks	Guidance
3	(a)		regulates fluidity of / stabilises / AW, membranes / phospholipid bilayer ; (converted to) steroid / named steroid, hormone(s) ; waterproofing the skin ; making Vitamin D ; making bile (salts) ;	2 max	**Mark the first answer on each prompt line.** **ACCEPT** decreases / maintains, fluidity **ACCEPT** supports structure of membranes **DO NOT CREDIT** makes membrane rigid **DO NOT CREDIT** allows / increases fluidity
3	(b)	(i)	contains C and H and O ; has, OH / hydroxyl, groups ; hex / 6-membered, ring ;	1 max	**Mark the first answer**. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **DO NOT CREDIT** C, H and O molecules **DO NOT CREDIT** hexose **ACCEPT** pent ring **IGNORE** 6C ring **IGNORE** branched
3	(b)	(ii)	(saturated) lipids / fats / triglycerides ; protein / polypeptide ;	2	**Mark the first two suggestions** **DO NOT CREDIT** unsaturated (fats) **IGNORE** fatty acids / glycerol **IGNORE** amino acids / peptides

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Question			Answer	Marks	Guidance
		(iii)	*LDL* **L1** (carry cholesterol) from liver to, tissues / cells **;** **L2** receptors on (tissue) cells **;** **L3** raise / AW, blood cholesterol **;** **L4** increase / cause, deposition of, fats / lipids / triglycerides / cholesterol, in artery wall / under endothelium **;** **L5** form, plaques / atheromas **;** *HDL* **H1** (carry cholesterol) from, tissues / body / blood, to liver **;** **H2** receptors on, hepatocytes / liver cells **;** **H3** lower / reduce / decrease, (blood) cholesterol **;** **H4** reduce deposition, of fats / lipids / triglycerides / cholesterol **;** **H5** decrease, formation / risk, of, plaques / atheromas **;**	6 max	If it is clear that candidates get LDL and HDL the wrong way round do not award L1 or H1 or QWC and then apply **ECF** **L3 IGNORE** deposits cholesterol **L4 IGNORE** LDL / fatty acids **L4 ACCEPT** under epithelium **H1 ACCEPT** back to liver **H3 ACCEPT** remove from blood **H4 IGNORE** LDL / fatty acids **H5 IGNORE** removing atheromas
			QWC – Award if you award an L mark and an H mark with the same number twice	1	e.g. L1 and H1, **and** L3 and H3

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Question			Answer	Marks	Guidance
	(c)	(i)	(red) meat contains (large amounts of) saturated, fat / fatty acids **;** (meat / saturated fat) associated with / leads to, increased / large amounts of, LDLs **;**	2	**ACCEPT** ora throughout for consequences of non-red meat diet No **ECF** from 3 (b) (iii) **ACCEPT** animal fat is saturated fat **CREDIT** high LDL/HDL ratio **IGNORE** makes LDLs unqualified answer must imply increased amount
		(ii)	(type 2) diabetes **;** angina / coronary heart disease / CHD / stroke / hypertension / high blood pressure / obesity **;**	1	**Mark the first answer**. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **DO NOT CREDIT** type 1 diabetes **IGNORE** conary **DO NOT CREDIT** chronic
			Total	**15**	

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Question			Answer	Marks	Guidance
4	(a)		taxonomy / taxonomic ; hierarchy ; phylogeny / phylogenetic ;	3	**Mark the first answer**. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **ACCEPT** phonetic spelling throughout **ACCEPT** hierarchical system
	(b)	(i)	**1** (cells have) no cell wall ; **2** heterotrophic ; **3** eukaryotic ; **4** multicellular ; **5** (fertilized eggs develop into), blastula / ball of cells ; **6** high degree of mobility / AW ;	2 max	**Mark the first answer on each prompt line.** **1 DO NOT CREDIT** absence of a qualified cell wall, e.g. 'no cellulose cell wall' **2 ACCEPT** phonetic spelling **3 ACCEPT** named eukaryotic cell feature **4 IGNORE** references to tissues **6 DO NOT CREDIT** unqualified references to movement **ACCEPT** refs to mobility during part of life cycle **IGNORE** cilia / flagella
		(ii)	Eukaryota(e) / Eukarya / eukaryote(s) ;	1	**Mark the first answer**. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **IGNORE** case of initial letter

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Question			Answer	Marks	Guidance
		(iii)		4 max	*Candidates may refer to individual species using common or scientific names.* ***ACCEPT*** *use of either or both.* ***IGNORE*** *case of initial letter*
			1 all are in same family as all, are closely related **;**		**1** idea of link between family and close relationship must be made
			2 kea and kaka are both, same genus / *Nestor* **;** **ora** for kakapo		
			3 kea and kaka, are more closely related / share more recent common ancestor, (than with kakapo) **;**		**3 ACCEPT** ora for less close relationship between kakapo and others
			4 kea and kaka have more genes in common / AW (than with kakapo) **;**		**4 ACCEPT ora** **4** Answers must refer to genes / genetics / DNA **4 IGNORE** cytochrome c
			5 example of genetic similarity (between kaka and kea) evident from Fig 4.1 **;**		**5** E.g. kaka and kea both brown / kaka and kea both have similar shaped beaks **5 IGNORE** unqualified references to appearance
			6 differences between, kea and kaka / all three, are great enough for each to be described as a different species **;**		
	(c)	(i)	differences **;** in / within / between, species **;**	2	**ACCEPT** within a population

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Question			Answer	Marks	Guidance
	(c)	(ii)	genetic differences / different alleles / inherited differences ; environment / diet / disease ;	2	**Mark the first suggestion on each prompt line.** **ACCEPT** different genes **ACCEPT** mutation **ACCEPT** sex **IGNORE** 'different habitat'
	(c)	(iii)	only small number have been sampled / AW ; *idea that* individuals sampled may not be representative of population ; data collected when population was larger / smaller population may mean range has changed ;	2	**Mark the first two reasons – ignore prompt lines.** **ACCEPT** 'whole population has not been sampled' **IGNORE** rare unqualified **ACCEPT** larger ones more likely to be caught / measured **ACCEPT** individuals sampled from one area might be different from average of whole population

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Question			Answer	Marks	Guidance
4	(d)		*Name* **1** speciation **;** *Mechanism – max 2 marks* **2** isolation / separation, (of populations) **;** **3** further detail of isolating mechanism **;** **4** mutation / genetic variation **;** **5** natural selection / description of natural selection **;** **6** different selection pressure(s) (in different environment) **;** **7** (enough) time to allow changes in population to prevent interbreeding / AW **;**	3 max	**1 IGNORE** 'natural selection' on name line **2 IGNORE** barrier **3** e.g. river, mountain, reproductive, geographical, temporal, polyploidy, qualified barrier **3 IGNORE** allopatric / sympatric unqualified **5** description must mention differential survival **and** genes being passed on **6 IGNORE** selection pressure unqualified **6** 'different' can be described using an example
			Total	**19**	

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Question			Answer		Marks	Guidance
5	(a)		41 667 ; ;		2	Award 2 marks for a correct answer, even if no working shown. **ALLOW** 1 mark for 41 666.666˙,41 666.7, 41 666.67, 41 666.667, 41 670, 41 700, 41 666, 41668 or 42 000. If the answer is incorrect **ALLOW** 1 mark for $\frac{2500 \times 100}{6}$
	(b)				3	**Mark the first three reasons regardless of lines**
			1	part of ecosystem / habitat for other organisms ;		**1 IGNORE** maintains biodiversity
			2	part of food, chain / web ;		**2 ACCEPT** food source **2 IGNORE** home
			3	wood useful for specific purpose ;		**3** e.g. making , fences / furniture / boundary marker
			4	(potential) source of medicine ;		
			5	genetic resource ;		**5 ACCEPT** description or example but must refer to genes
			6	aesthetic value / give pleasure / beautiful trees ;		**6 ACCEPT** tourism
			7	ethical reason / moral responsibility ;		**7 ACCEPT** *idea that* they have a right to existence **7 DO NOT CREDIT** 'playing God'
			8	resource for (non-medical) scientific research ;		

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Question			Answer		Marks	Guidance
	(c)	(i)	not in, natural / normal, habitat / environment **;**		1	
		(ii)	**1**	most plants produce an excess **;**	4 max	
			2	(so) can be collected (from wild) without damaging (wild) , plants / organisms / population / habitat **;**		
			3	take up little space **; ora**		
			4	able to store, large numbers / more species **; ora**		
			5	easy / cheaper, to transport / AW **; ora**		**5 ACCEPT** can easily be sent where wanted
			6	*idea of* remaining viable for long periods **; ora**		**6** Answers must have some reference to survival, not just 'can be stored for a long time'
			7	less susceptible to, disease / pests / environmental change **; ora**		**7 IGNORE** recovery / survival , from disease **7 CREDIT** answers that describe (greater) disease resistance as a property of the seeds themselves **or** that the seed bank is a (more) protected environment for the seeds **IGNORE** cheaper unqualified

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Question			Answer		Marks	Guidance
5	(c)	(iii)	1	(maintain / increase) genetic variation / gene pool ;	3 max	**1 ACCEPT** different alleles **1 DO NOT CREDIT** different genes
			2	reduced chance of (future), disease / environmental change, affecting (whole) population ;		**2 ACCEPT** 'so if one dies from a disease some might survive' **2 ACCEPT** 'to get some plants that are resistant to different diseases'
			3	reduces chance of inbreeding ;		
			4	maintain, geographical variation / varieties / races / strains / subspecies ;		**4 IGNORE** variation unqualified
				Total	**13**	

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<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>6</td><td>(a)</td><td></td><td>
<table>
<tr><td>Characteristics are passed on to the next generation</td><td>W</td><td>;</td></tr>
<tr><td>There is a struggle for existence</td><td>Y and Z</td><td>;</td></tr>
<tr><td>Individuals with beneficial characteristics are among the few who survive</td><td>X and Y and Z</td><td>;</td></tr>
</table>
</td><td>3</td><td>DO NOT CREDIT if letter is unclear

DO NOT CREDIT if more than one letter is given

DO NOT CREDIT if an incorrect letter is given

DO NOT CREDIT if an incorrect letter is given</td></tr>
<tr><td></td><td>(b)</td><td></td><td>MRSA / it, is harder to treat / may become untreatable ;

potential for, disease outbreak / epidemic / pandemic / killing many people ;

developing new / more powerful, <u>antibiotics</u>, is expensive / takes time ;</td><td>2 max</td><td>ACCEPT MRSA / it, can’t be killed (by antibiotics)
ACCEPT antibiotics will no longer work on, MRSA / it

IGNORE new antibiotics are hard to discover</td></tr>
</table>

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Question			Answer		Marks	Guidance
6	(c)		1	fossils show that organisms have changed over time ;	3	**1 CREDIT** many fossil organisms dissimilar from modern organisms
			2	*idea that* fossils or rocks can be dated ;		**2 ACCEPT** idea of fossils in chronological order
			3	*idea of* fossils showing intermediate forms / sequences ;		**3** e.g. *Archaeopteryx* / *Tiktaalik* / horse **3** general trend from, small / simple, to, large / complex
				Total	**8**	

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<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>7</td><td>(a)</td><td></td><td>
<table>
<tr><td>form part of cellular response</td><td>both</td></tr>
<tr><td>mature in thymus</td><td>(only) T (lymphocytes) ;</td></tr>
<tr><td>secrete substances which kill infected cells</td><td>(only) T (lymphocytes) ;</td></tr>
<tr><td>manufacture antibodies</td><td>(only) B (lymphocytes) ;</td></tr>
<tr><td>undergo clonal expansion</td><td>both / B and T ;</td></tr>
<tr><td>activate other lymphocytes</td><td>(only) T (lymphocytes) ;</td></tr>
</table>
</td><td>5</td><td></td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>no antibodies detected before 4 days / antibodies appear at 4 days ;

increase then decrease / peak ;

figures for peak with time and antibody concentration ;

decrease less steep than increase / AW ; ora
antibody concentration returns to zero at 27 days ;</td><td>3 max</td><td>ACCEPT ‘around 4 days’
ACCEPT upper limit of 4.5 days for first appearance of antibodies
IGNORE ‘before 5 days’
IGNORE references to increase at 4 days, answers must imply none to begin with

ACCEPT 13 days ± 0.5 day, 25 units ± 0.5 units
ACCEPT 25 au ± 0.5 au 9 days ± 0.5 day after initial appearance</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

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<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>7</td><td>(b)</td><td>(ii)</td><td>the drawn line should show
higher peak and steeper initial increase ;

antibodies appear between days 30 and 34 and concentration at 60 days above peak for primary response ;</td><td>2</td><td>Peak must be at least 30 au
Compare gradient with initial increase up to day 10
NBOD if gradients are similar
ACCEPT ruled line close to vertical

DO NOT CREDIT vertical
ACCEPT a line that starts to rise at 30 or 34 days</td></tr>
<tr><td>7</td><td>(c)</td><td></td><td><table><tr><th>region</th><th>name</th><th>function</th></tr><tr><td>A</td><td>hinge (region) ;</td><td>flexibility / binding of more than one antigen ;</td></tr><tr><td>B</td><td>constant / Fc (region) ;</td><td>attachment / binding , to phagocytes ;</td></tr><tr><td>C</td><td>variable / hypervariable / Fab (region) ;</td><td>binding / attachment , to antigens ;</td></tr></table></td><td>6</td><td>Marks for name and function should be awarded independently.
DO NOT CREDIT if incorrect answer appears in same box
ACCEPT hinges / hinged

ACCEPT neutrophils / macrophages / granulocytes
ACCEPT monocytes

IGNORE recognise antigens</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>16</td><td></td></tr>
</table>

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RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

BIOLOGY

Molecules, Biodiversity, Food and Health

F212

Candidates answer on the question paper.

OCR supplied materials:
None

Other materials required:
- Electronic calculator
- Ruler (cm/mm)

Thursday 26 May 2011
Afternoon

Duration: 1 hour 45 minutes

F 2 1 2

F2157306111

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined pages at the end of this booklet. The question number(s) must be clearly shown.
- Answer **all** the questions.
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **100**.
- Where you see this icon you will be awarded marks for the quality of written communication in your answer.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.
- This document consists of **28** pages. Any blank pages are indicated.

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Answer **all** the questions.

1 **(a)** Plants are the producers in most food chains.

Complete the following passage by using the most appropriate terms from the list to fill the gaps.

A term should **not** be used more than once.

cellulose	**nucleic acids**	**respiration**
lipids	**photosynthesis**	**starch**
monomers	**proteins**	**sucrose**

Plants carry out the process of ..... in which energy from the sun is used to produce a storage carbohydrate such as ..... .

Plants also absorb phosphates which are used to produce ..... . When humans eat the plants, the various polymers are hydrolysed to ..... and absorbed, but molecules such as ..... cannot be digested by humans and are egested. **[5]**

(b) Fig. 1.1 shows the yield of rye plants (in tonnes per hectare) grown on the same soil for 80 years. These plants were grown without the addition of nitrogen fertiliser.

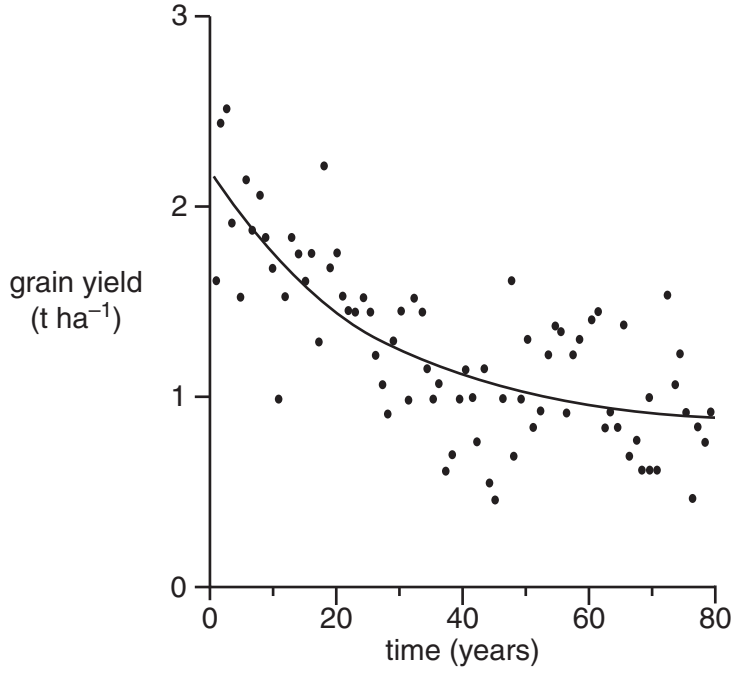


Fig. 1.1

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Using Fig. 1.1 and your own knowledge, explain why nitrogen fertiliser needs to be applied to farmland.

.....

.....

.....

.....

.....

.....

.....

..... **[3]**

(c) Insect pests, such as aphids, can reduce yield in rye plants by piercing the phloem and removing materials.

Aphids can be killed using an insecticide. However, over a period of time, an increasing concentration of insecticide is required to control the aphid population.

Explain why this is the case.

.....

.....

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..... **[4]**

[Total: 12]

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2 **(a)** Enzymes are biological catalysts.

Explain the term *biological catalyst*.

.....

.....

.....

.....

..... **[2]**

(b) When the enzyme catalase is added to hydrogen peroxide, the following reaction occurs:

$$\underset{\text{hydrogen peroxide}}{H_2O_{2(l)}} \xrightarrow{\text{catalase}} 2\,H_2O_{(l)} + O_{2(g)}$$

In an investigation into the effect of temperature on the rate of this reaction, a student set up apparatus as shown in Fig. 2.1, using liquidised celery as a source of catalase.

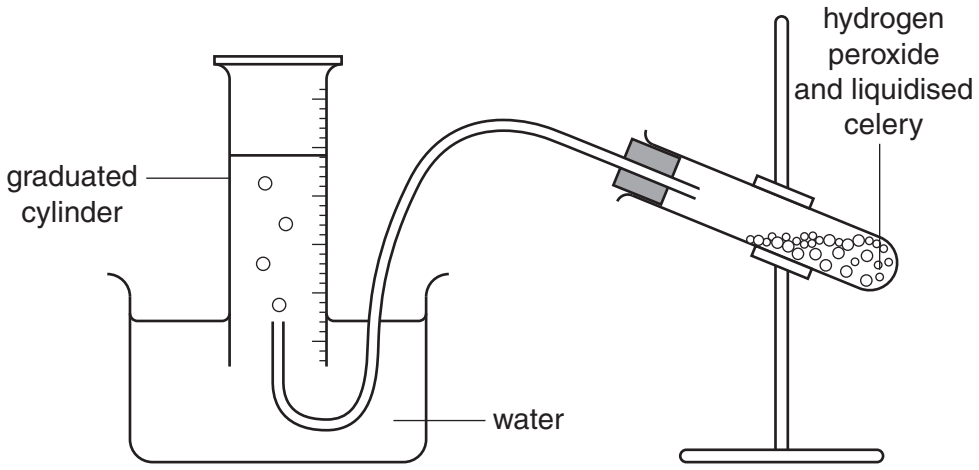


Fig. 2.1

The student measured the volume of oxygen produced at five different temperatures using samples of the liquidised celery.

(i) State the other variable that needs to be measured in order to calculate the **rate** of reaction.

..... **[1]**

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(ii) Identify **one** potential problem with using samples of liquidised celery as a source of catalase in this investigation **and** suggest a way to minimise this problem.

.....

.....

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.....

..... **[2]**

(iii) The student collected the data shown in Table 2.1.

Table 2.1

temperature (°C)	volume of oxygen (cm^3)
5	4
10	7
12	10
25	28
28	32

Suggest how the student could check the reliability of the data.

.....

.....

.....

.....

.....

..... **[2]**

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(c) Another student carried out a similar procedure and presented his results as a graph. The graph that he drew is shown in Fig. 2.2.

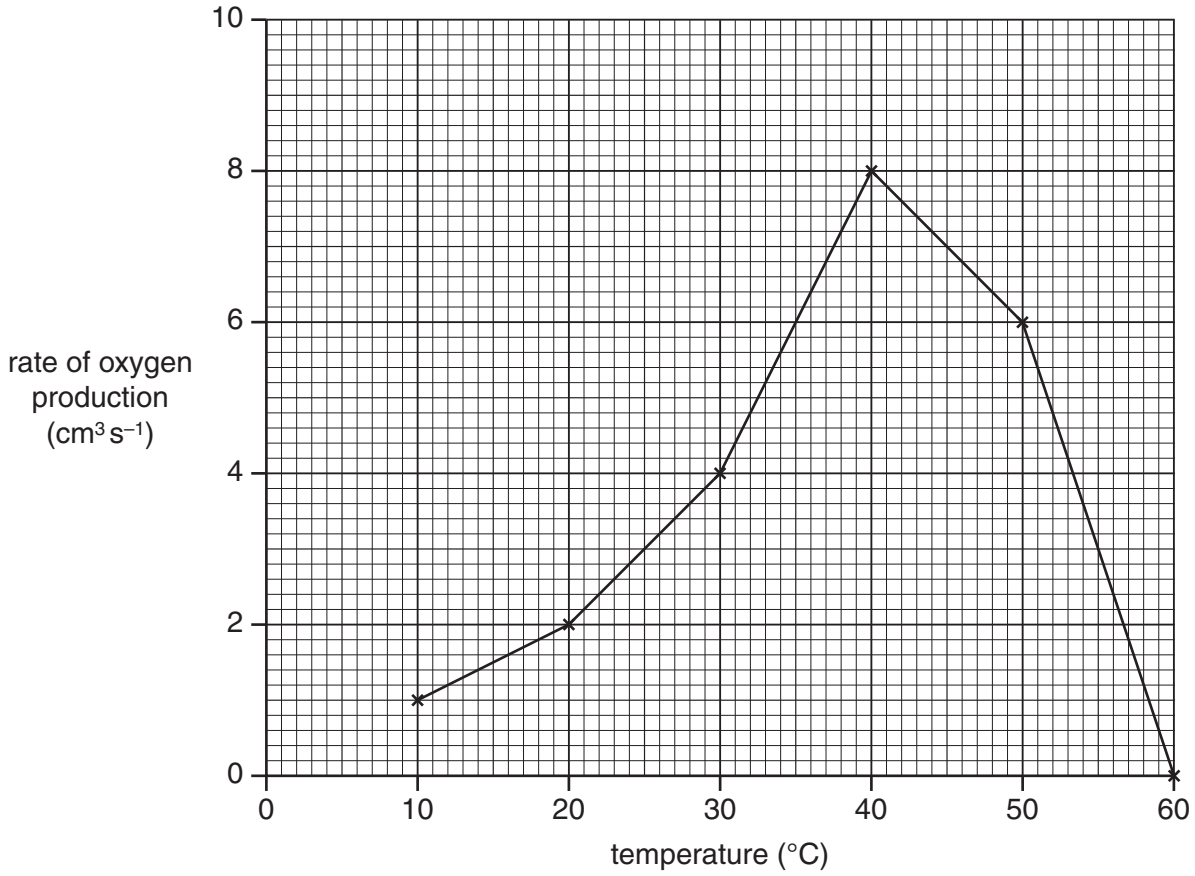


Fig. 2.2

(i) Describe the data shown in Fig. 2.2.

.....

.....

.....

.....

.....

.....

.....

..... **[4]**

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(ii) Q_{10} is a measure of the increase in the rate of reaction for a 10 °C rise in temperature.

It is calculated using the following formula:

$$Q_{10} = \frac{\text{rate at } (t + 10\,°C)}{\text{rate at } t\,°C}$$

where $t + 10$ °C = rate at the higher temperature
t = rate at the lower temperature

Using the information in Fig. 2.2, calculate Q_{10} between 15 °C and 25 °C.

Show your working.

Answer = ... **[1]**

(iii) In the conclusion to this experiment, the student wrote the following:

> ***As the heat increased, the reaction went faster until it got to its highest. After this, the rate of reaction fell. This happened because the enzyme was killed and the hydrogen peroxide could not fit into the enzyme's key site.***

Suggest a more appropriate word to replace each of the underlined words.

heat should be replaced with .....

highest should be replaced with .....

killed should be replaced with .....

key should be replaced with ..... **[4]**

[Total: 16]

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3 A number of different biological molecules are represented in Fig. 3.1.

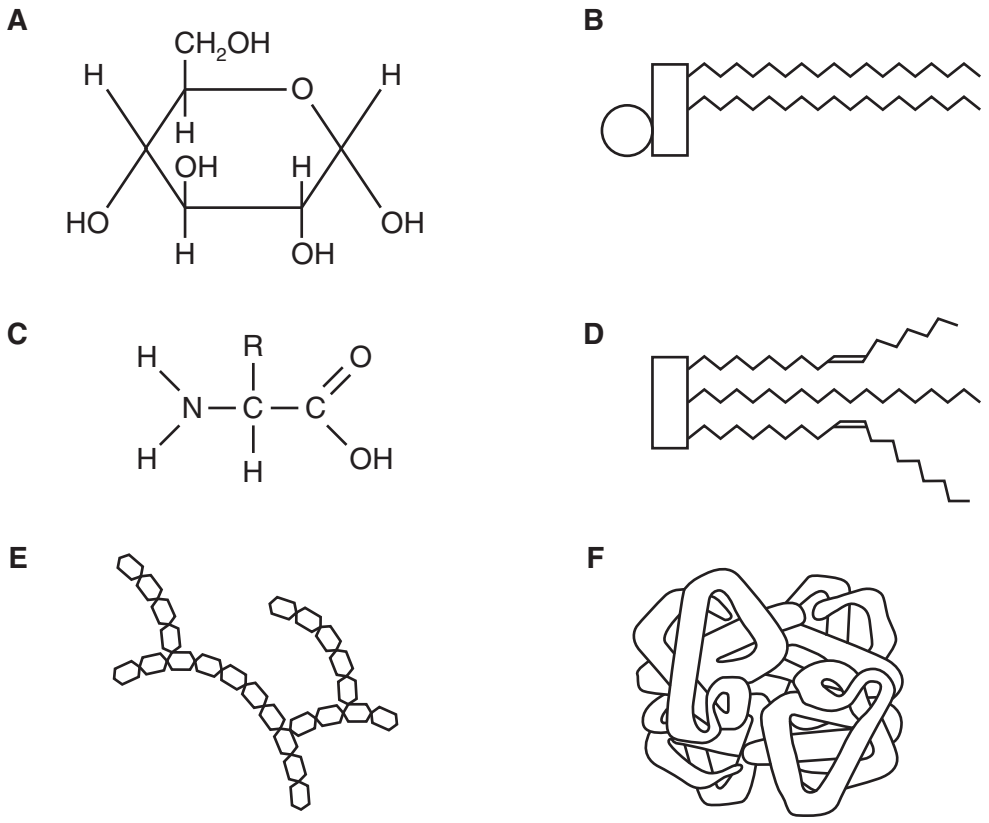


Fig. 3.1

(a) (i) State the letter of the molecule shown in Fig. 3.1 that represents:

a triglyceride .....

a monosaccharide .....

a protein ..... **[3]**

(ii) State the letter of the molecule shown in Fig. 3.1 that contains:

phosphate .....

glycosidic bonds .....

peptide bonds .....

disulfide bonds ..... **[4]**

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(b) Molecule **E** shown in Fig. 3.1 is part of the carbohydrate molecule glycogen.

Explain why glycogen makes a good storage molecule.

.....

.....

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.....

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..... **[3]**

(c) **(i)** When glycogen is hydrolysed, molecule **A** shown in Fig. 3.1 is produced.

State the **precise name** of molecule **A** ..... **[1]**

(ii) State **one** function of molecule **A.**

.....

..... **[1]**

(iii) State the letter of a molecule shown in Fig. 3.1, other than molecule **E**, that is used as a storage molecule.

..... **[1]**

QUESTION 3(d) STARTS ON PAGE 10

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(d) Cellulose is a carbohydrate molecule found in plants.

Complete the table below to give three **differences** in the **structures** of glycogen and cellulose.

One difference has been done for you.

glycogen	cellulose
no hydrogen bonding	*hydrogen bonding*

[3]

[Total: 16]

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PLEASE DO NOT WRITE ON THIS PAGE

QUESTION 4 STARTS ON PAGE 12

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4 **(a)** Each winter, the UK government recommends that vulnerable members of the public are vaccinated against the influenza (flu) virus.

(i) State **two** groups of people that the government would consider as being vulnerable.

1 .....

.....

2 .....

..... **[2]**

(ii) Suggest why the influenza vaccine has to be changed each year.

.....

.....

.....

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..... **[2]**

Fig. 4.1 shows the concentration of antibodies in a patient's bloodstream following an influenza vaccination and then infection with the influenza virus.

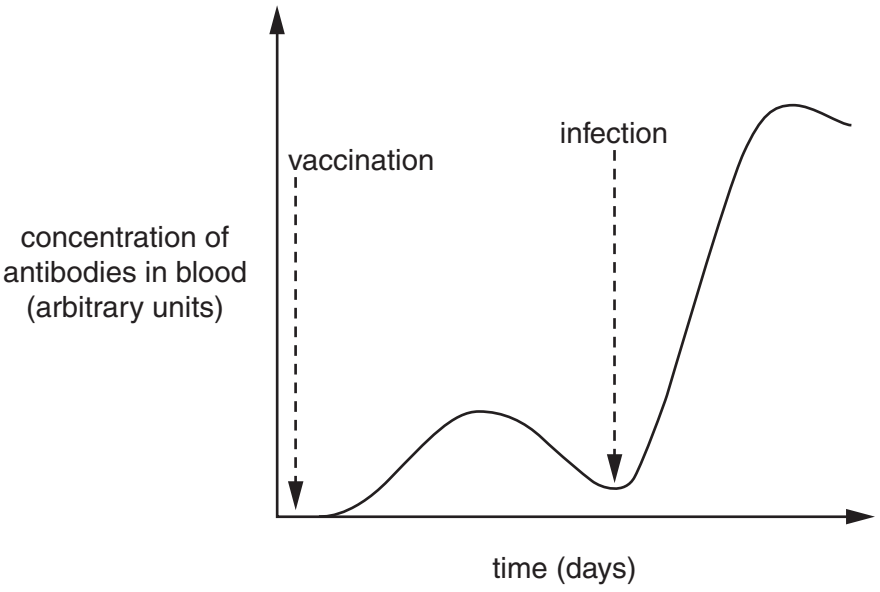


Fig. 4.1

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(iii) Using the information from Fig. 4.1, state **two differences** between the primary and secondary immune responses.

.....

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..... **[2]**

(iv) Memory cells are produced when a patient is vaccinated against influenza.

Describe the role of these memory cells when the influenza virus enters the body.

.....

.....

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..... **[3]**

QUESTION 4(b) STARTS ON PAGE 14

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(b) Tamiflu® is an antiviral drug that can be used to treat influenza patients.

(i) State why a doctor would **not** prescribe antibiotics to treat influenza.

.....

..... **[1]**

(ii) Neuraminidase is an enzyme which is present on the protein coat of the influenza virus.

This enzyme is used to break down the host cell membrane and allow the influenza viruses to leave the infected cell. Tamiflu® is a neuraminidase inhibitor.

Suggest how Tamiflu® could inhibit neuraminidase.

.....

.....

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.....

..... **[2]**

(iii) Suggest how Tamiflu® could help to reduce the spread of influenza.

.....

.....

.....

.....

.....

..... **[2]**

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(c) In an effort to find new drugs to combat a possible new influenza pandemic, researchers have investigated plants used in traditional medicine in Nepal. Two plants, an onion, *Allium oreoprasum*, and an asparagus, *Asparagus filicinus*, have been found to show antiviral properties.

Suggest why researchers in Nepal concentrated their research on plants that had been used in traditional medicine.

.....

.....

.....

.....

..... **[2]**

[Total: 16]

QUESTION 5 STARTS ON PAGE 16

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5 **(a)** Fig. 5.1 shows the relationship between the mean number of cigarettes smoked per person per year and the incidence of lung cancer for both men and women between 1900 and 1990.

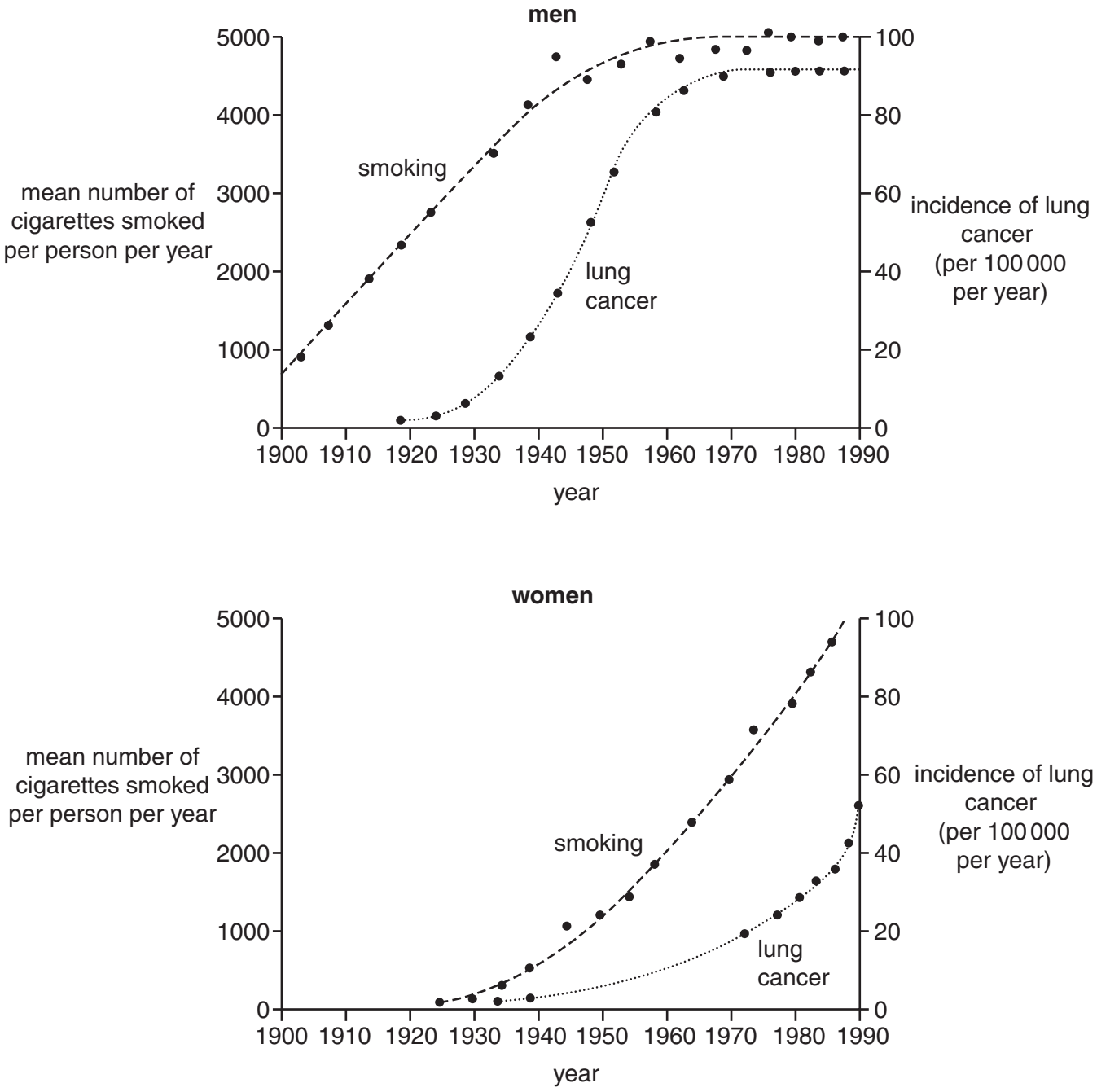


Fig. 5.1

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(i) Compare the changes in the patterns of **smoking** in men and women from 1900 to 1990.

.....

.....

.....

.....

.....

..... **[2]**

(ii) What evidence from Fig. 5.1 suggests that smoking causes lung cancer?

.....

.....

.....

.....

.....

..... **[2]**

QUESTION 5(b) STARTS ON PAGE 18

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(b) Describe how smoking contributes to the development of lung cancer.

In your answer, you should make clear the links between smoking and the development of lung cancer.

[6]

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(c) Name **three other** diseases associated with smoking.

1 .....

2 .....

3 ..... **[3]**

[Total: 13]

QUESTION 6 STARTS ON PAGE 20

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6 **(a)** Fig. 6.1 shows two species of trilobites, a group of arthropods that became extinct about 240 million years ago. Species **A** is 20 million years older than species **B**.

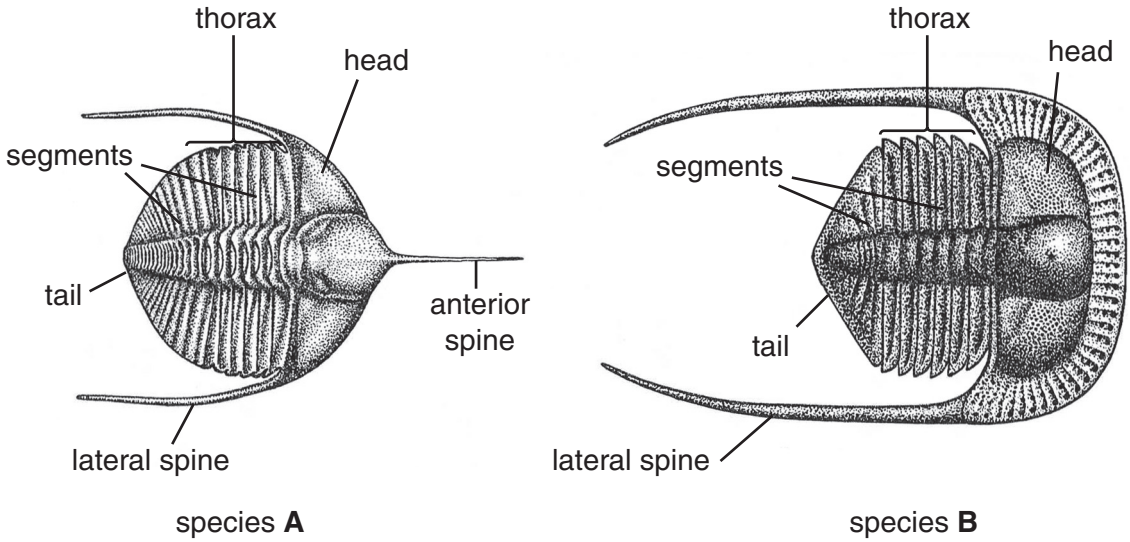


Fig. 6.1

(i) List **three** observable features from Fig. 6.1 that suggest the two species are related.

1 .....

2 .....

3 ..... **[3]**

(ii) List **two** observable features from Fig. 6.1, **other than size**, that could suggest they are **different** species.

1 .....

2 ..... **[2]**

(b) Explain how fossils provide evidence for the theory of evolution.

.....

.....

.....

.....

.....

..... **[2]**

[Total: 7]

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QUESTION 7 STARTS ON PAGE 22

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7 **(a)** Fig. 7.1 represents part of a DNA molecule.

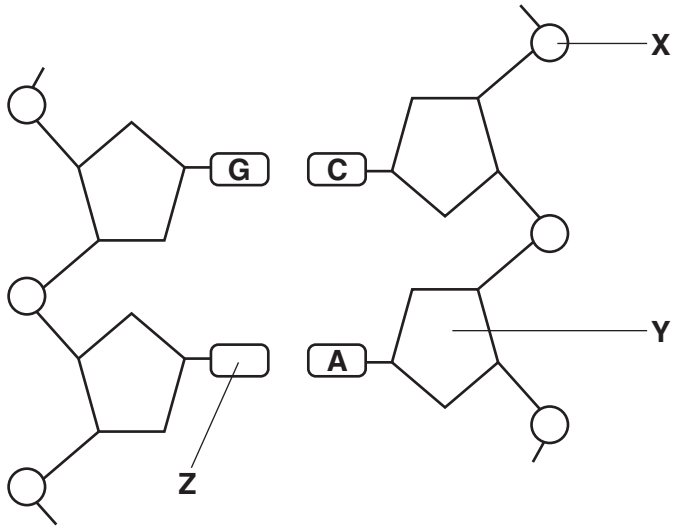


Fig. 7.1

State the **precise name** of each of the parts of the DNA molecule labelled **X**, **Y** and **Z**.

X .....

Y .....

Z ..... **[3]**

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(b) Describe how the DNA molecule replicates.

In your answer, you should make clear the sequence of events.

.... [7]

[Total: 10]

QUESTION 8 STARTS ON PAGE 24

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8 On Christmas Eve 1987, the last female Spix's Macaw, *Cyanopsitta spixii*, was removed from the wild in Brazil. The last remaining male bird continued to live in the wild for a further six years. This male bird, having lost its partner, mated with a Blue-winged Macaw, *Propyrrhura maracana*.

(a) Explain why eggs produced by this mating did not hatch.

.....

.....

.....

.....

.....

..... **[2]**

(b) Spix's Macaws became endangered because the birds were illegally trafficked to collectors in other parts of the world. This is against the CITES agreement.

(i) State what the abbreviation CITES stands for.

.....

..... **[1]**

(ii) State **two** of the aims of the CITES agreement.

1 .....

.....

2 .....

..... **[2]**

(c) Once it was realised that the Spix's Macaws were in danger of becoming extinct, the collectors were "invited" to allow their macaws to take part in a breeding programme.

Suggest **two** factors to be taken into consideration when selecting individuals for this breeding programme.

.....

.....

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.....

..... **[2]**

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(d) Finally, a captive bred female Spix's Macaw was released into the original male's territory.

What could be done to try to ensure the success of this release programme?

.....

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.....

.....

..... **[3]**

[Total: 10]

END OF QUESTION PAPER

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ADDITIONAL PAGE

If additional space is required, you should use the lined pages below. The question number(s) must be clearly shown.

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GCE

Biology

Advanced Subsidiary GCE

Unit **F212:** Molecules, Biodiversity, Food and Health

Mark Scheme for June 2011

Oxford Cambridge and RSA Examinations

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Question			Expected Answers		Mark	Additional Guidance
1	(a)		photosynthesis ; starch ; nucleic acids ; monomers ; cellulose ;		5	**Mark the first answer in each space.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **ACCEPT** minor mis-spellings
1	(b)					**IGNORE** 'nutrients/ minerals' throughout
			1	without fertiliser <u>yield</u> falls (over time) / fertiliser maintains <u>yield</u> / AW ;		**1** **ACCEPT** it / nitrate / nitrogen as AW for fertiliser **ACCEPT** fertiliser increases yield
			2	application of fertiliser replaces lost , nitrogen / nitrates ;		**2** **ACCEPT** it / nitrate / nitrogen as AW for fertiliser
			3	nitrogen / N, required for , amino acids / (named) protein / growth / (named) nucleic acids / (named) nitrogenous base ;		**3** **IGNORE** 'development' **IGNORE** fertiliser / nitrate / N_2
			4	*idea that* nitrogen / N / nitrate / $NO_3^{(-)}$, removed (from soil / system) by , plant / harvesting ;		**4** Answers must refer to depletion (from soil) 'used' alone does not imply depletion
			5	*idea of* denitrification ;		
			6	nitrates / $NO_3^{(-)}$, are soluble ;		
			7	nitrates / $NO_3^{(-)}$, are , leached / washed from soil ;	3 max	

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Question			Expected Answers		Mark	Additional Guidance
1	(c)					**ACCEPT** 'tolerance' as AW for resistance If candidates write 'immunity' penalise once and then ecf
			1	natural selection **;**		
			2	insecticide is the **,** selective agent / selection pressure **;**		
			3	*idea of* mutation / (genetic) variation **;**		**3** **DO NOT CREDIT** idea of insecticide or natural selection *causing* mutation **DO NOT CREDIT** variation that could be environmental
			4	random / naturally occurring **;**		
			5	resistant survive / non-resistant die **;**		**5** **ACCEPT** AW for resistant, e.g. 'the ones with the mutation'
			6	(resistants will) pass on **,** allele / mutation **,** for resistance (to offspring) **;**		**6** **ACCEPT** gene for resistance **IGNORE** 'pass on resistance / trait'
			7	higher proportion of / more **,** resistant individuals in population **;**		**7** **CREDIT** refs to increased allele / gene frequency **ACCEPT** 'the whole population becomes resistant'
			8	*idea that* resistance allele confers resistance only to a small dose of insecticide **;**	**4 max**	
				Total	**[12]**	

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Question			Expected Answers		Mark	Additional Guidance
2	(a)		(enzymes are) proteins / used in metabolism / used in named metabolic pathway ; alter rate of (chemical) reaction / lowers activation energy / provides alternative route for reaction / is not changed / is not used up ;		2	**ACCEPT** 'used in reactions , in organisms / in the body' **IGNORE** 'biological / enzyme / in nature' **ACCEPT** does not take part in reaction **Note** 'speed up metabolic reactions' **= 2 marks**
2	(b)	(i)	time ;		1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **IGNORE** 'how long' **IGNORE** correct units
2	(b)	(ii)	**P1**	*idea of* different samples have different concentrations of, catalase / enzyme ;		The M mark can be awarded without a correct P mark **P1** Look for the idea of variation within the sample (e.g. different amounts) **CREDIT** examples of lack of uniformity such as: breakage of cells / surface area / mixing / disruption of lysosomes / changes to enzyme shape (caused by blending process) / presence of other substances interfering with reaction **IGNORE** refs to celery being a poor source of catalase
			One of			
			M1	source the extract for the whole experiment from a single source ;		**M1 ACCEPT** 'from same plant'
			M2	thorough , mixing , required before use ;		
			M3	filter / purify , extract ;		
			M4	*idea of* using , known / standard , concentration of enzyme ;		
			M5	commercial source of catalase ;	2	

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Question			Expected Answers	Mark	Additional Guidance
2	(b)	(iii)	repeat / replicate ; compare replicate values / identify anomalous results ; mean / range / standard deviation / error bars / % error ; compare results with , others / book / internet , values / results ;	2 max	e.g compare replicates with Table 2.1 **IGNORE** average Must contain the idea of other investigators **ACCEPT** 'look up normal values on the internet'
2	(c)	(i)			**IGNORE** explanations
		1	rate , rises / increases , initially ;		1 **DO NOT CREDIT** if 'rate' not stated for this mp only
		2	peak at / maximum at / highest at / decrease after, 40(°C) ;		2 **ACCEPT** optimum
		3	(overall) fall more rapid than rise ;		3 Look for a comparative statement
		4	*idea that* before peak / after peak , temperature increase has increasing effect on rate ;		4 **ACCEPT**, e.g., line is steeper between 30 and 40 than between 10 and 20.
		5	comparative figures to support any point ;		5 Two temperatures and two rates, **with units**. Or calculated difference with appropriate units, e.g. rate doubles between 10 and 20°C **or** Q_{10} = 2
		6	no , reaction / oxygen produced , at 60(°C) ;	4 max	6 **ACCEPT** rate is 0 at 60
2	(c)	(ii)	2 ;	1	**IGNORE** units
2	(c)	(iii)	temperature ; maximum / peak / V_{max} ; denatured ; active ;	4	**Mark the first answer for each letter.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **ACCEPT** kinetic energy / KE **ACCEPT** optimum / optimum temperature **IGNORE** descriptions
			Total	[16]	

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Question			Expected Answers		Mark	Additional Guidance
3	(a)	(i)	D ; A ; F ;		3	**Mark the first answer for each letter.** If an additional answer is given then = **0 mark**
3	(a)	(ii)	B ; E ; F ; F ;		4	**Mark the first answer for each letter** If an additional answer is given then = **0 marks**
3	(b)		**1** **2** **3** **4** **5** **6**	insoluble ; does not , change / affect , water potential / Ψ , of cell ; can be , broken down / hydrolysed / built up , quickly / easily ; lots of branches for enzymes to attach ; compact ; (therefore) high energy content for mass / energy dense / AW ;	3 max	**2** **ACCEPT** osmotically inactive / AW **3** Answers must contain the idea of ease or speed of breakdown **IGNORE** broken up Answers must imply density, e.g. 'it is compact and so stores a lot of energy' = 2 marks

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Question			Expected Answers		Mark	Additional Guidance
3	(c)	(i)	α /alpha , glucose ;		1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **ACCEPT** 'α'
3	(c)	(ii)	**1** **2** **3** **4**	respiratory substrate / used for respiration ; source of / releases / provides, energy ; formation of ATP ; conversion into named compound ;	1 max	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **DO NOT CREDIT** any answer that clearly states that glucose **is** energy, **makes** energy, **produces** energy or **creates** energy **1** **ACCEPT** used in respiration **ACCEPT** 'releases energy for respiration' **2** **IGNORE** used for energy **4** e.g. starch / cellulose / polysaccharide / disaccharide / glycogen / protein / lipid / sucrose / maltose / fructose / fat
3	(c)	(iii)	D ;		1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **ACCEPT** F **IGNORE** triglyceride / fat / lipid / haemoglobin

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<table>
<tr><th colspan="3">Question</th><th>Expected Answers</th><th>Mark</th><th>Additional Guidance</th></tr>
<tr><td>3</td><td>(d)</td><td></td><td>
<table>
<tr><th>glycogen</th><th>cellulose</th><th></th></tr>
<tr><td>no hydrogen bonding</td><td>hydrogen bonding</td><td></td></tr>
<tr><td>α / alpha , glucose</td><td>β / beta , glucose</td><td>;</td></tr>
<tr><td>1,4 <u>and</u> 1,6-glycosidic bonds
or
1,6-glycosidic bonds present</td><td>1,4-glycosidic bonds (only)
or
1,6-glycosidic bonds not present</td><td>;</td></tr>
<tr><td>branched</td><td>not branched / linear / straight</td><td>;</td></tr>
<tr><td>no , fibres / fibrils</td><td>fibres / fibrils</td><td>;</td></tr>
<tr><td>granules</td><td>no granules</td><td>;</td></tr>
<tr><td>all glucose units in same orientation</td><td>adjacent glucose units in opposite orientation</td><td>;</td></tr>
</table>
</td><td>3 max</td><td>Comparative statements must be made on the same line
Award 1 mark for each correct side by side comparison. ALLOW two valid comparisons in the same pair of boxes, e.g
<table><tr><td>α-glucose in a branched chain</td><td>β-glucose in a straight chain</td></tr></table>= 2 marks

ACCEPT ‘α’ and ‘b’

ACCEPT helical / spiral / coiled vs linear / straight
DO NOT CREDIT α-helix</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>[16]</td><td></td></tr>
</table>

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Question			Expected Answers		Mark	Additional Guidance
4	(a)	(i)				**Mark the first answer on each numbered line.**
			1	the elderly / older people **;**		**1 ACCEPT** ref to any age over 50
			2	'at risk' children / young people **;**		**2 ACCEPT** the young / infants / babies **IGNORE** refs to age
			3	pregnant women **;**		
			4	those with compromised immune systems **;**		**4 ACCEPT** weak **ACCEPT** e.g. with AIDS / HIV / on immunosuppressant drugs / ref cancer
			5	those with chronic diseases **;**		**5 ACCEPT** e.g. heart conditions / lung conditions / asthma / diabetes
			6	health workers **;**		
			7	poultry workers / pig farmers **;**	**2 max**	**7 ACCEPT** other professions working with animals, e.g. vets
4	(a)	(ii)	different strains of the virus / virus mutates (each year) **;**			**IGNORE** 'different types' or 'virus changes' or 'different strands' **ACCEPT** (influenza) pathogen
			(new strains have) different antigens **;** *idea that* antibody produced **,** needs to match new strain / antigen **; ora**		**2 max**	**CREDIT** antigenic shift / drift **ora** original antibody does not match new antigen

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Question			Expected Answers		Mark	Additional Guidance
4	(a)	(iii)	secondary response **,** starts earlier / has shorter delay before response **;** **ora** secondary response **,** more rapid / faster **;** **ora** secondary response **,** higher / produces more antibodies **;** **ora**		**2 max**	**Mark the first <u>two</u> differences** **IGNORE** answers, e.g. 'size of response' or 'response is faster' that do not refer to a feature of the secondary or primary response **CREDIT** 'shorter lag time' **ACCEPT** steeper **ACCEPT** bigger **IGNORE** 'secondary response lasts longer' as this is not clear from graph
4	(a)	(iv)	**1**	recognise **,** virus / antigen / pathogen **;**	**3 max**	**1** **ACCEPT** description of recognition **IGNORE** find / detect
			2	produce a clone **;**		**2** **ACCEPT** ref to clonal expansion **ACCEPT** 'divide by mitosis to produce large numbers'
			3	can , change to / form **,** plasma cells (on infection) **;**		
			4	make antibodies (against influenza **,** virus / antigen) **;**		**4** **IGNORE** 'reproduce antibodies' **IGNORE** 'release antibodies'
			5	responsible for secondary response / destroy virus before symptoms appear **;**		**5** **IGNORE** refs to speed of response unqualified
			6	can , change to / form **,** named T-cell **;**		

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Question			Expected Answers		Mark	Additional Guidance
4	(b)	(i)	(antibiotics) are, not effective against viruses / effective (only) against bacteria (and fungi / protozoa) ;		1	**ACCEPT** antibiotics do not kill viruses **IGNORE** viruses are resistant to antibiotics **ACCEPT** correct ref to detail of antibiotic action, e.g. 'antibiotics attack cell wall which is not present in influenza (virus)'
4	(b)	(ii)	**1**	Tamiflu® is , competitive / non-competitive inhibitor ;	2 max	
			2	correct detail of inhibition method that does not contradict stated type of inhibition ;		**2** e.g. fits or binds to active site / complementary shape to active site / competes for the active site **OR** fits into allosteric site or site other than active site **/** changes shape of active site
			3	prevents , substrate binding to active site / formation of enzyme-substrate complex / formation of ESC ;		**3** **IGNORE** substrate binding to enzyme
4	(b)	(iii)	fewer , viruses / pathogens , produced ; fewer , viruses / pathogens , (in droplets) when , sneezing / coughing ; (as) viruses / pathogens , cannot leave cell ; (so) cannot , infect / spread to , other cells ; *idea of* treating , large / proximate , population ;		2 max	**IGNORE** herd immunity / ring vaccination
4	(c)		(plants) already identified as likely to have , medicinal properties / few side effects / AW ; reduces , time / effort , in finding , plants / active chemicals ; (possibly) reduces cost ;		2 max	**ACCEPT** 'known / proven to work' **ACCEPT** reduced time for testing
				Total	[16]	

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Question			Expected Answers	Mark	Additional Guidance
5	(a)	(i)	both rise (between 1920 and 1960) ; men started smoking before, ca. 1900 / women's smoking started increasing after 1920 - 1925 ; similar levels of smoking (in men and women) by 1990 ; smoking in men , levelled off / plateaued **OR** smoking in women continues to rise ;	**2 max**	Needs direct comparison in single statement **ACCEPT** comparative statement, e.g. 'women started smoking later than men' **ACCEPT** 5000 in both by the end of the 1980s **DO NOT CREDIT** if plateau described before 1940
5	(a)	(ii)	(positive) correlation / similar pattern , between smoking and lung cancer ; *idea that* increase in incidence of lung cancer lags behind increase in smoking ; *idea of* once smoking has levelled off there is a corresponding levelling off in incidence of lung cancer ; *idea of* men always smoking more and men having higher rates of cancer ; **ora**	**2**	**ACCEPT** similar shaped graphs **IGNORE** 'as smoking increases, so does lung cancer' **ACCEPT** followed by **ACCEPT** if answer implies levelling off at same time

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Question			Expected Answers		Mark	Additional Guidance
5	(b)		1	tar / (cigarette) smoke , contains carcinogens / is carcinogenic ;		1 **IGNORE** cigarettes
			2	benzopyrene / formaldehyde / other e.g. ;		
			3	enters , lung / epithelial , cells ;		
			4	*idea that* destroyed cilia prevent removal of , carcinogens / tar , which then have greater contact time with epithelial cells ;		
			5	enters nucleus / in contact with DNA ;		5 'contact with DNA' needs to be stated not implied
			6	causes mutation ;		6 **IGNORE** description
			7	proto-oncogenes to oncogenes ;		7 **ACCEPT** switching on (proto)oncogenes
			8	uncontrollable , cell division / mitosis ;		8 **ACCEPT** cell multiplication **IGNORE** growth **IGNORE** ref to speed of cell division
			9	formation of , tumour / mass of cells ;		9 **ACCEPT** lump (of cells)
			10	no , programmed cell death / apoptosis ;	5 max	
			QWC ~ showing link between smoking and lung cancer ;		1	1 mark awarded from mps **1** to **5** **and** 1 mark awarded from mps **6** to **10**

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Question			Expected Answers	Mark	Additional Guidance
5	(c)				**Mark the first answer on each numbered line.**
			1 mouth / tongue / throat / oesophageal **,** cancer **;**		**1 ACCEPT** <u>secondary</u> cancers
			2 <u>chronic</u> bronchitis / COPD **;**		**2 DO NOT CREDIT** smoker's cough
			3 emphysema / COPD **;**		**3 CREDIT** COPD once only
			4 <u>ath</u>erosclerosis **;**		
			5 thrombosis **;**		**5 IGNORE** thrombus
			6 coronary heart disease / CHD / angina / heart attack / myocardial infarction / MI **;**		**6 IGNORE** cardiovascular disease / hypertension / chronic heart disease
			7 stroke **;**		
			8 peripheral vascular disease / <u>arterio</u>sclerosis **;**		
				max 3	
			Total	**[13]**	

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Question			Expected Answers	Mark	Additional Guidance
6	(a)	(i)	3 parts to body ; head + thorax + tail ; segmented ; lateral spines / spines from both sides of head ; thorax / tail , similar shape ;	3 max	**Mark the first answer on each numbered line.** **ACCEPT** wherever seen **ACCEPT** 'a lateral spine' **ACCEPT** description of thorax / tail shape
6	(a)	(ii)	anterior spine (from head) on A ; longer lateral spines on B ; less rounded / AW , head on B ; any other reasonable difference ; ;	2 max	**Mark the first answer on each numbered line.** Answers must state either species A or species B **ACCEPT** ora throughout e.g. (greater) fusion of tail segments in B grooves around edge of head in B outline of tail section (more) curved in A A has more segments **CREDIT** any clear description of a difference
6	(b)		***1*** *idea of* fossils show changes over time ; ***2*** *idea that* there are methods to date fossils ; ***3*** *idea of* simplest / most different from modern , species / AW , in oldest rocks ; ***4*** *idea of* showing , links / relationships , between , groups / species / organisms / taxa ; ***5*** many fossils organisms no longer exist ; ***6*** *idea of* compare DNA extracted from some fossils ;	2 max	**2** **ACCEPT** it is possible to date fossils **4** **ACCEPT** ref to common ancestor of two species Answers could refer to links between species A and species B
			Total	[7]	

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Question			Expected Answers	Mark	Additional Guidance
7	(a)		**X** phosphate ;		**Mark the first answer for each letter.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks**
			Y deoxyribose ;		**DO NOT CREDIT** PO_4 or 'phosphate , molecule / backbone' **IGNORE** group
			Z thymine ;	3	**DO NOT CREDIT** deoxyribulose **IGNORE** (pentose) sugar
					DO NOT CREDIT incorrect spelling **IGNORE** (nitrogenous) base / T

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Question			Expected Answers		Mark	Additional Guidance
7	(b)					**CREDIT** answers from clearly labelled diagram **IGNORE** anything after it becomes clear that a candidate is ***describing*** transcription
			1	semi-conservative (replication) ;		
			2	(double) helix, untwists / uncoils / unwinds / unravels ;		**2** **IGNORE** straightens **DO NOT CREDIT** α-helix
			3	hydrogen bonds (between bases) break ;		**3** **IGNORE** unzips
			4	each strand acts as the template (for the formation of a new molecule) ;		
			5	free (DNA) nucleotides (align with exposed bases) ;		**5** **IGNORE** in cytoplasm
			6	complementary base pairing / purine to pyrimidine ;		**6** **IGNORE** A to T / C to G (as given in Q) **ACCEPT** base pair rule
			7	hydrogen bonds (re)form ;		
			8	sugar-phosphate backbone forms / adjacent nucleotides join ;		**8** **CREDIT** formation of phosphodiester bond
			9	DNA polymerase joins , backbone / strands ;		**9** **ACCEPT** in context of H bonds forming
			10	each new molecule has 1 old and 1 new strand ;		**10** **DO NOT CREDIT** half old and half new strand
			11	AVP ;		**11** e.g. correct ref to , (DNA) helicase (in context of unwinding or unzipping) / (DNA) ligase (in context of joining Okazaki fragments or role in backbone formation) / leading or lagging strand / 3' / 5' / antiparallel / activation of free nucleotides / 3 H bonds between C and G / 2 H bonds between A and T / Okazaki fragments / proof reading
					6 max	
			QWC ~ events in correct sequence so long as no ref to transcription / translation , seen ;		**1**	1 mark from mps **2** to **4** ***then*** 1 mark from mps **5** to **7** ***then*** mp **8** or **9**
				Total	**[10]**	

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Question			Expected Answers	Mark	Additional Guidance
8	(a)		**1** different species ; **2** different genus ; **3** genetically incompatible ; **4** (may have) different number of chromosomes ; **5** physical / behavioural , reason for reproductive incompatibility ;	**2 max**	**3 ACCEPT** 'DNA sufficiently different' **IGNORE** refs to meiosis **4 IGNORE** refs to meiosis **5** e.g. eggs remain unfertilised / different incubation patterns **IGNORE** refs to fertility of offspring
8	(b)	(i)	Convention (on) International Trade (in) Endangered Species ;	**1**	**ACCEPT** Commission / Conference / Congress **ACCEPT** Trading **DO NOT CREDIT** Conservation / Countries
8	(b)	(ii)	**1** regulate / monitor , trade in selected , species / animals / plants / animal products ; **2** *idea of* ensuring trade does not put wild populations at risk ; **3** *idea of* prohibiting commercial trade in wild plants ; **4** *idea of* allowing trade in artificially propagated plants ; **5** *idea of* allowing trade in less endangered species subject to permit ;	**2 max**	**Mark the first two answers only.** **IGNORE** trafficking throughout (as in stem) **1 ACCEPT** idea of species being on a list **ACCEPT** endangered **ACCEPT** prevent **IGNORE** illegal **IGNORE** animals / plants unqualified **3 ACCEPT** endangered plants

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Question			Expected Answers		Mark	Additional Guidance
8	(c)		unrelated / AW, individuals ; health ; of reproductive age ; selecting individuals of opposite sex (for breeding) ; select higher proportion of females ;		2 max	**ACCEPT** idea of individuals with sufficiently different genes **ACCEPT** 'whether they are healthy (or not)' **ACCEPT** fertility of individuals
8	(d)		**1** bird(s) healthy / quarantine before release ; **2** adequate (natural) food supply / provide food (if necessary) ; **3** protected reserve / no hunting / no poaching / legal protection ; **4** method to monitor population ; **5** raise public awareness / educate local population / educate collectors ; **6** method to prepare animals for survival in wild ; **7** *idea of* gradual introduction, e.g via semi-wild habitat ;		3 max	**1** **IGNORE** refs to ongoing health monitoring **3** **ACCEPT** ref to controlling predators **4** e.g. tag birds **5** **ACCEPT** involve local population **6** e.g. raise with minimal human contact, predator awareness training **ACCEPT** teaching it to find food
			Total		[10]	

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RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

BIOLOGY

F212

Molecules, Biodiversity, Food and Health

Candidates answer on the question paper.

OCR supplied materials:
None

Other materials required:
- Electronic calculator
- Ruler (cm/mm)

Tuesday 18 January 2011
Afternoon

Duration: 1 hour 45 minutes

OCE/25766

F 2 1 2

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined pages at the end of this booklet. The question number(s) must be clearly shown.
- Answer **all** the questions.
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **100**.
- Where you see this icon you will be awarded marks for the quality of written communication in your answer.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.
- This document consists of **28** pages. Any blank pages are indicated.

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Answer **all** the questions.

1 The condition known as AIDS is widespread in some parts of the world.

(a) (i) Identify the infective agent that causes AIDS.

..... **[1]**

(ii) The government has introduced needle exchange programmes for drug users.

Explain how this may help reduce the transmission of AIDS.

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..... **[2]**

(b) Fig. 1.1 shows a simplified diagram of the structure of the infective agent that causes the condition known as AIDS.

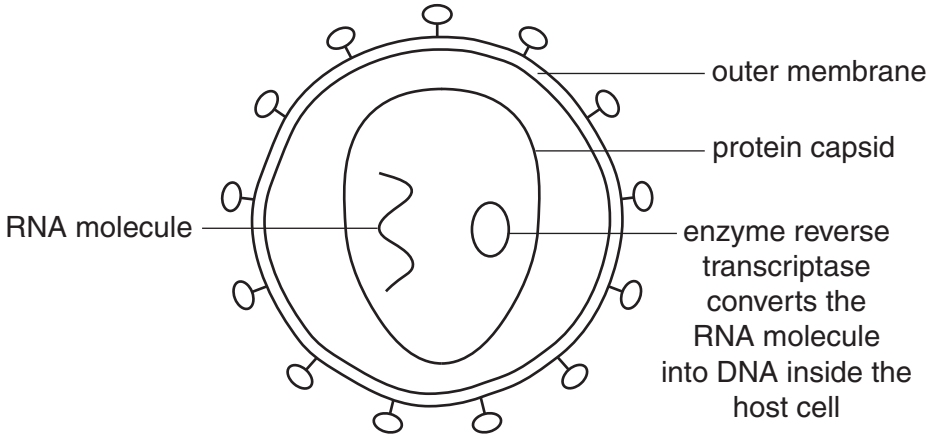


Fig. 1.1

(i) The proteins in the capsid and the RNA molecules are polymers. Polymers are made up of smaller monomer subunits.

Name the monomers that make up:

proteins .....

RNA ..... **[2]**

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(ii) The infective agent that causes AIDS takes control of the T lymphocytes of the host.

Using the information in Fig. 1.1, suggest why the infective agent is able to 'take control' once it has entered the T lymphocytes.

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..... **[2]**

(c) People with AIDS frequently become ill following infection with opportunistic diseases such as tuberculosis (TB).

(i) State **three** factors that increase the chance of infection with TB.

1 .....

2 .....

3 ..... **[3]**

(ii) When an infection occurs, some T lymphocytes produce cell signalling molecules called cytokines. These cytokines stimulate specific groups of B lymphocytes to divide.

Describe how cytokine molecules can stimulate specific groups of B lymphocytes to divide.

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..... **[3]**

[Total: 13]

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2 Fig. 2.1 shows part of an **amylose** molecule. This is an unbranched form of starch.

When iodine solution is added to starch, iodine fits into the helix of the amylose molecule, producing a colour change.

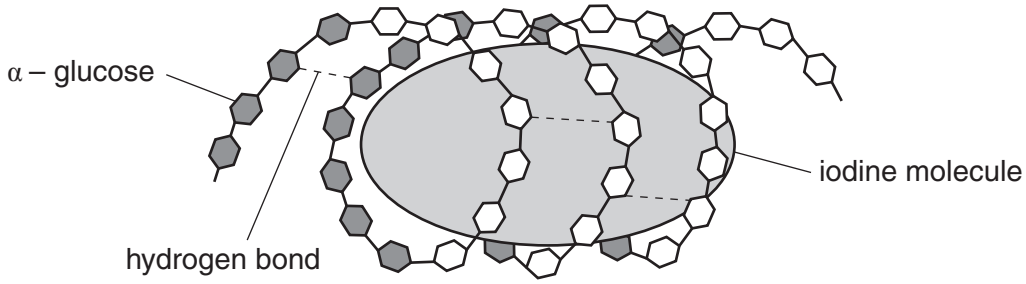


Fig. 2.1

(a) (i) State the colour of iodine solution in the presence of starch.

..... **[1]**

(ii) Hydrogen bonds hold the amylose molecule in its helical shape.

Describe how a hydrogen bond is formed.

.....

.....

.....

.....

..... **[2]**

(iii) Using the information in Fig. 2.1, suggest what would happen to the iodine-amylose complex if the solution was heated to 60 °C.

.....

.....

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.....

..... **[2]**

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(b) **Amylase** is an enzyme that hydrolyses amylose to maltose. Maltose, like glucose, is a reducing sugar.

A student investigated the action of amylase on amylose. She mixed amylase with amylose and placed the mixture in a water bath.

Describe how she could measure the change in concentration of maltose (reducing sugar) as the reaction proceeds.



In your answer, you should ensure that the steps in the procedure are sequenced correctly.

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..... **[7]**

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(c) Fig. 2.2 shows the results that the student obtained from a practical procedure in which the rate of formation of maltose was measured in the presence and absence of chloride ions.

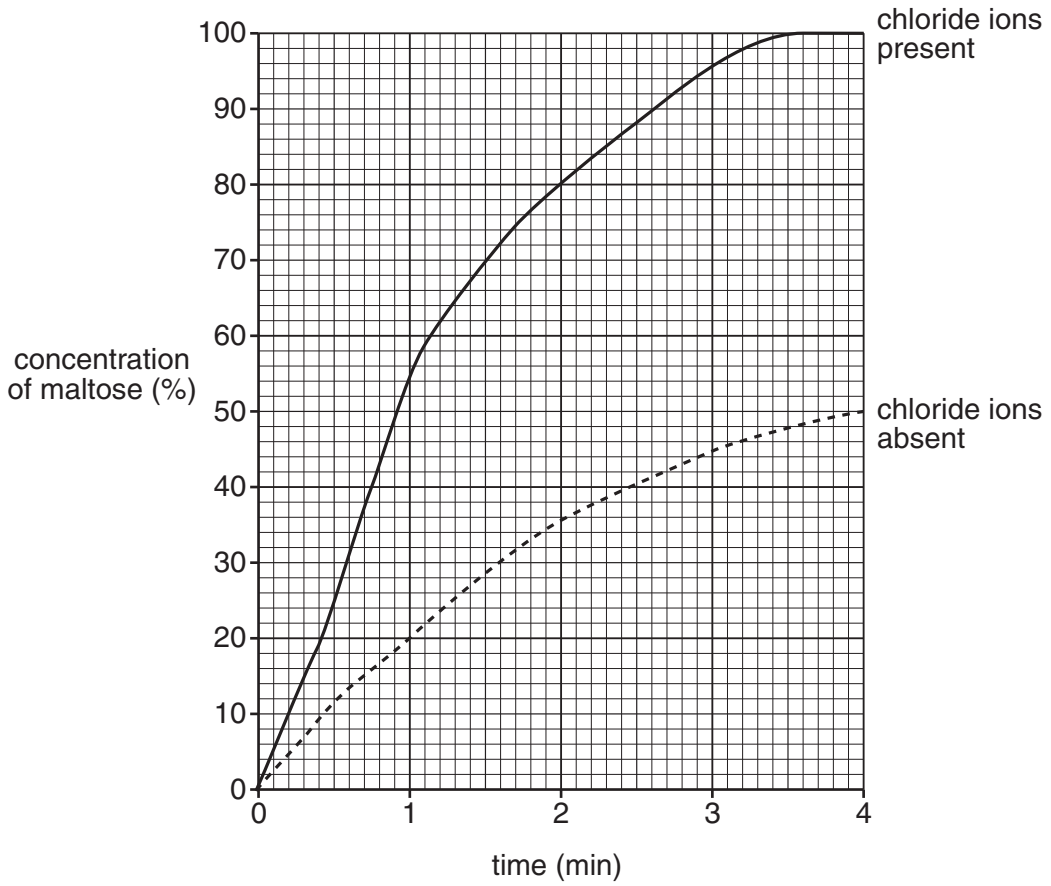


Fig. 2.2

(i) Describe the effect of chloride ions on the rate of reaction.

.....

.....

.....

.....

..... **[2]**

(ii) Suggest how chloride ions have this effect on the rate of reaction.

.....

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.....

.....

..... **[2]**

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(iii) State **three** variables that need to be controlled in this practical procedure in order to produce valid results.

1 .....

2 .....

3 ..... **[3]**

[Total: 19]

QUESTION 3 STARTS ON PAGE 8

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3 Part of the Cairngorms National Park in the Scottish Highlands is at an altitude of approximately 1000 metres. It presently supports a range of plants and animals including some that are normally found in sub-arctic conditions.

Table 3.1 shows the breeding success of a number of bird species between 1970 and 2000. Specialist sub-arctic species are marked with an asterisk *.

Table 3.1

species	number of young raised per year			
	1970	1980	1990	2000
snow bunting *	78	69	36	2
Lapland bunting *	7	3	0	0
ptarmigan *	1280	1134	960	876
red grouse	890	920	933	962
wheatear	209	240	190	231
meadow pipit	23	45	48	82
ring ouzel	23	21	29	26
dotterel *	45	43	39	35

* = specialist sub-arctic species

(a) (i) Using the data in Table 3.1, compare the breeding success of the sub-arctic species and the non sub-arctic species between 1970 and 2000.

.....

.....

.....

.....

.....

.....

..... **[3]**

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(ii) Suggest **two** reasons for the trends described.

.....

.....

.....

.....

..... **[2]**

(b) A study of insects was carried out in the same area of the Cairngorms National Park to determine species richness.

(i) What is meant by species richness?

.....

..... **[1]**

(ii) The insects were sampled using a sweep net method. Fig. 3.1 shows a sweep net being used. With this method, a net is swept through the vegetation. Insects are removed, identified and counted.

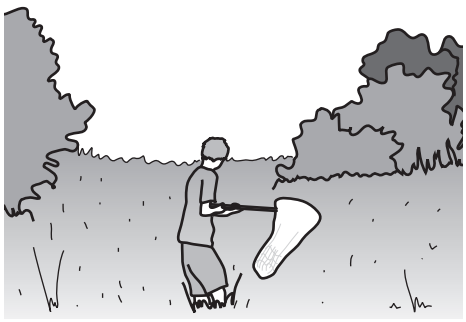


Fig. 3.1

Describe **three** ways in which the sampling procedure could be designed to try to make sure that a representative sample was obtained.

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..... **[3]**

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(iii) Species evenness also contributes to the measurement of biodiversity.

Explain the importance of species evenness in determining the biodiversity in a habitat.

.....

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..... **[3]**

[Total: 12]

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QUESTION 4 STARTS ON PAGE 12

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4 **(a)** The World Health Organisation has promoted the concept of health.

What is meant by the term *health*?

.....

.....

.....

.....

..... **[2]**

(b) The body has adaptations that provide it with a primary defence against the entry of pathogens and parasites.

State **two** features of the body that form part of the primary defence.

For each feature, explain how it **helps to prevent the entry** of pathogens and parasites into the body.

feature 1 .....

explanation .....

.....

.....

feature 2 .....

explanation .....

.....

..... **[4]**

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(c) Fig. 4.1 shows the life cycle of the threadworm. This is a common parasite in young children.

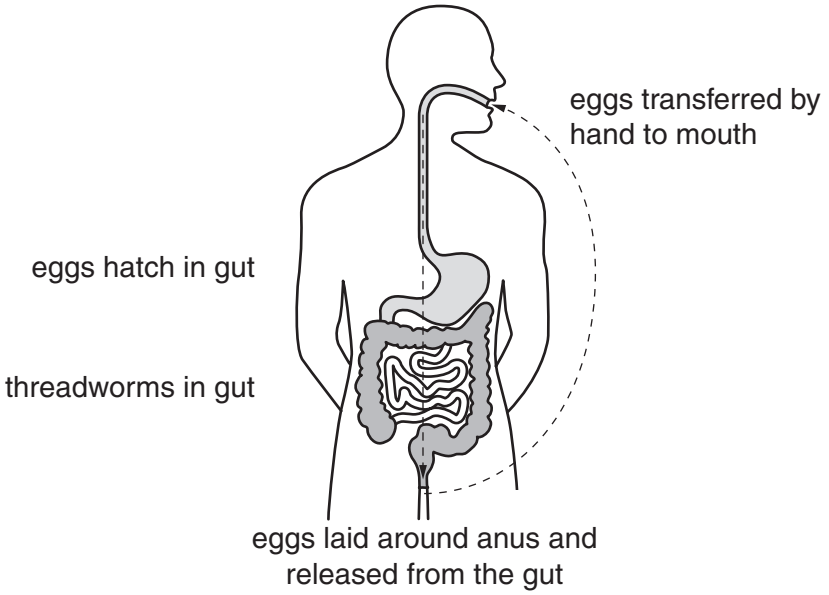


Fig. 4.1

(i) Define the term *parasite* **and** suggest how the threadworm benefits from this relationship.

.....

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.....

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.....

..... **[4]**

(ii) Using the information in Fig. 4.1, suggest **two** ways in which the cycle of infection could be broken.

.....

.....

.....

..... **[2]**

[Total: 12]

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5 DNA and RNA are nucleic acids.

(a) The table below contains a number of statements relating to nucleic acids.

Complete the table, using a letter **D**, **R** or **B**, to show whether each statement applies to:

- DNA only (**D**)
- RNA only (**R**)
- both DNA and RNA (**B**).

The first one has been done for you.

statement	DNA only (**D**) or RNA only (**R**) or both DNA and RNA (**B**)
contains thymine	D
contains ribose	
consists of two chains connected to each other with hydrogen bonds	
has a sugar-phosphate backbone	
has four different nitrogenous bases	
contains a pentose sugar	
is found in the nucleus and cytoplasm	

[6]

(b) It has been found that 98.4% of chimpanzee DNA is identical to that of a human.

(i) Suggest how the information obtained by DNA analysis can be useful to taxonomists.

.....

.....

.....

..... **[2]**

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(ii) State **two** types of evidence, other than biochemical evidence, that are used by taxonomists when classifying organisms.

.....

.....

.....

..... **[2]**

(c) Cytochrome C is a protein found in living organisms. The structure of cytochrome C varies between different organisms. However, closely related organisms have similar cytochrome C.

Fig. 5.1 shows a possible evolutionary tree for vertebrates.
Common ancestors are indicated by the number 1 and various letters.

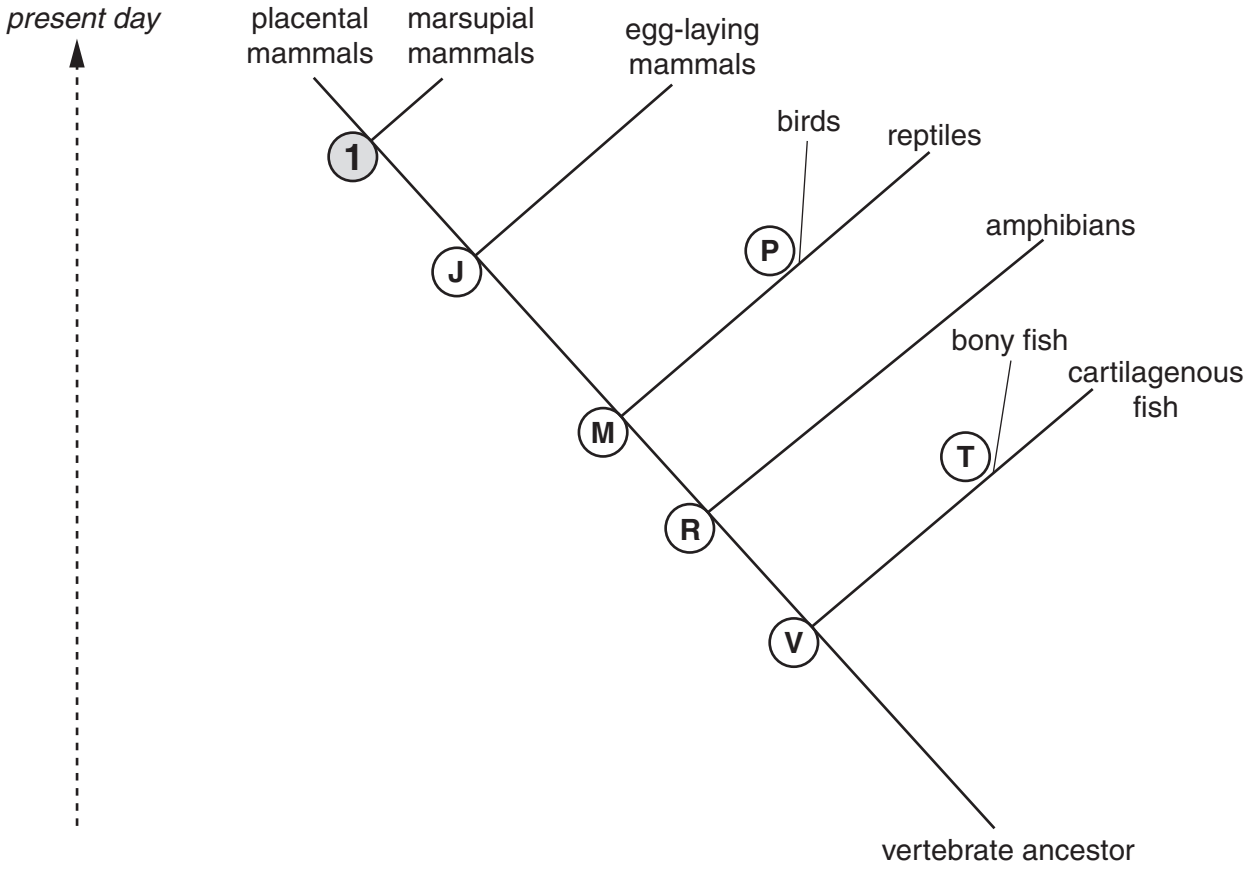


Fig. 5.1

State the **letter** of the common ancestor that has cytochrome C which will be:

most similar in structure to common ancestor **1** .....

least similar in structure to common ancestor **1** ..... **[2]**

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(d) The pine marten is a small mammal that is rare in the United Kingdom. Its numbers are particularly low in Wales and there have been few confirmed sightings of this animal in the past 50 years. There have been plans to introduce pine martens from other areas of the United Kingdom into Wales to increase the size of the population.

The DNA of museum specimens of Welsh pine martens in the National Museum of Wales was tested, the most recent specimens dating from 1948. The DNA analysis suggests that Welsh pine martens are genetically distinct from those found elsewhere in the United Kingdom.

(i) The relevance of this analysis has been questioned by some scientists.

Suggest why the findings from the museum specimens may not relate closely to the current pine marten population of the United Kingdom.

.....

.....

..... **[1]**

(ii) Suggest why some people are concerned about the plan to introduce pine martens from other areas into Wales.

.....

.....

..... **[1]**

[Total: 14]

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QUESTION 6 STARTS ON PAGE 18

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6 An important aspect of food production is maximising productivity. Maximum productivity can be achieved in a number of different ways.

(a) In selective breeding, humans look for variation between members of the same species and use this variation to improve productivity.

(i) State the **two** different causes of variation.

1 .....

2 ..... **[2]**

Fig. 6.1 is a scattergraph that shows the growth rate and egg productivity in a flock of chickens.

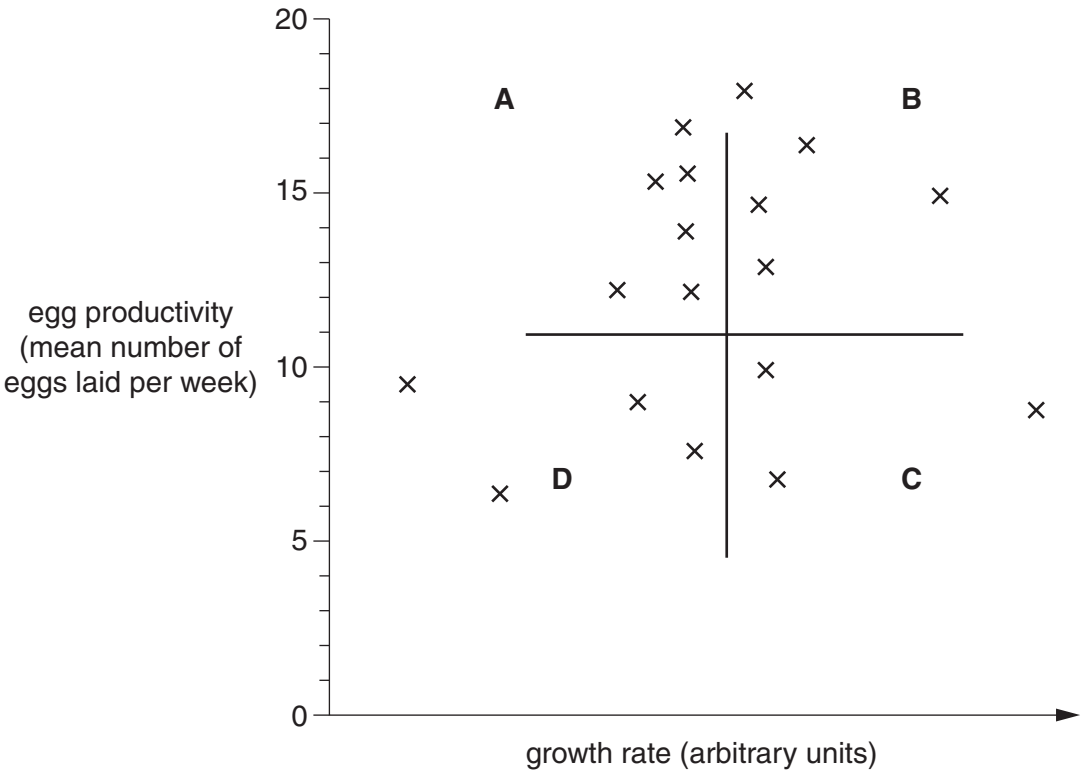


Fig. 6.1

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(ii) The growth rate of the chickens in Fig. 6.1 shows **continuous** variation.

Describe **three** characteristics of this type of variation.

.....

.....

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.....

..... **[3]**

(iii) A chicken breeder divides the flock into four groups, **A**, **B**, **C** and **D**, as shown in Fig. 6.1.

State which group of chickens, **A**, **B**, **C** or **D**, he should use to breed from in order to improve the growth and productivity of the flock.

..... **[1]**

(iv) Suggest **two undesirable** consequences of selective breeding in chickens.

.....

.....

.....

.....

..... **[2]**

(v) The wild ancestor of the domestic chicken is the red jungle fowl found in the rainforests of South East Asia.

Explain why it is important to preserve the population of the red jungle fowl.

.....

.....

.....

.....

..... **[2]**

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(b) In the past, domestic chickens were given antibiotics as a growth promoter.

(i) When antibiotic growth promoters were used, it was claimed that the meat was of better quality, with less fat and increased protein content.

Suggest **two further** benefits of using antibiotics.

1 .....

.....

2 .....

..... **[2]**

(ii) The use of antibiotics as growth promoters in animal production was banned in the European Union in 2006.

Suggest a concern that led to this ban.

.....

.....

..... **[1]**

[Total: 13]

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QUESTION 7 STARTS ON PAGE 22

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7 **(a)** Haemoglobin is a globular protein.

Describe the structure of a haemoglobin molecule.



In your answer, you should include details of the secondary, tertiary and quaternary structure of the molecule.

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..... **[7]**

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(b) Describe the ways in which the structure of collagen is **similar** to the structure of haemoglobin.

.....

.....

.....

.....

.....

.....

.....

..... **[4]**

[Total: 11]

QUESTION 8 STARTS ON PAGE 24

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8 Complete the following passage by selecting the most suitable term from the list below.

Each term may be used once, more than once or not at all.

antibiotics	**natural**
antibodies	**non-specific**
antibody	**specific**
antigen	**vaccination**
artificial	**vaccines**

The body can acquire immunity in a number of different ways.

In passive immunity, ... are introduced directly into the body. This may occur via breast milk or the placenta, in which case it is described as ..... immunity. This immunity provides the growing child with valuable protection until its immune system has developed fully. It is sometimes important to provide immediate protection, such as when a person has a wound that could be contaminated with tetanus bacteria. In this case, suitable blood serum from another individual is injected into the bloodstream to provide ..... immunity.

Edward Jenner pioneered the technique of stimulating the immune system into action so that the body develops immunity without developing the symptoms of the disease. Jenner's technique mimics the way in which the body would develop ..... immunity from direct contact with the pathogen and the stimulation of the primary response. Nowadays, a harmless form of the ..... is injected so that the body develops antibodies and memory cells for future defence. This technique is known as ..... . **[6]**

[Total: 6]

END OF QUESTION PAPER

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ADDITIONAL PAGE

If additional space is required, you should use the lined pages below. The question number(s) must be clearly shown.

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GCE

Biology

Advanced Subsidiary GCE

Unit **F212:** Molecules, Biodiversity, Food and Health

Mark Scheme for January 2011

Oxford Cambridge and RSA Examinations

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Question			Expected Answer	Mark	Additional Guidance
1	(a)	(i)	human immunodeficiency virus / HIV **;**	1	**DO NOT CREDIT** if there is any ref to AIDS
1	(a)	(ii) 1	(infective agent), in blood / body fluids **;**	2 max	**1 ACCEPT** any infective agent even if incorrect as question asks for *mode of transmission*
		2	*idea of:* used needles are contaminated **; ora**		**2 ACCEPT** e.g. 'used needles are infected' **2 ACCEPT** e.g. 'new needles are sterile' **2 DO NOT CREDIT** 'dirty' / 'clean' needles
		3	reduces chance of sharing needles **; ora**		**3 IGNORE** 'prevents' / 'stops'
1	(b)	(i)	amino acid(s) **;** nucleotide(s) **;**	2	*Answers must be on correct line* **ACCEPT** phonetic spelling for both **DO NOT CREDIT** if ref to DNA / 'nucleosides' **ACCEPT** 'ribonucleotides'
1	(b)	(ii) 1	reverse transcriptase in (host) nucleus **;**	2 max	
		2	viral DNA, (inserted) in (host), chromosome / DNA **;**		
		3	*idea of:* (viral) RNA / mRNA produced / transcribed **;**		
		4	(to) code for / make / translate, viral proteins **;**		**4 IGNORE** 'different protein'

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Question			Expected Answer	Mark	Additional Guidance
1	(c)	(i)			**Mark the first three answers only regardless of which line they are on**
		1	not vaccinated against TB **;**		**1 IGNORE** general refs to lack of medical care
		2	weakened immune system **;**		
		3	(lifestyle) e.g. poor diet / lack of protein / malnourished / smoking / alcoholism **;**		**3 DO NOT CREDIT** 'alcohol' unqualified **IGNORE** 'poor health'
		4	homelessness **;**		
		5	poor ventilation (of housing) / AW **;**		
		6	overcrowding **;**		
		7	close contact with people from / visiting, area where TB is common **;**		**7 ACCEPT** area where those with TB are not quarantined
		8	close / prolonged, contact with individual(s) with TB **;**		
		9	consumption of milk or beef, from infected cattle / in developing countries **;**		
				3 max	

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Question			Expected Answer	Mark	Additional Guidance
	(c)	(ii)			
		1	cytokine / interleukin / receptor has, specific / unique, shape ;		**1 DO NOT CREDIT** 'cytokine is specific to receptor' as this is implied in question
		2	(cytokine / interleukin), binds / attaches / bonds to / fits into, receptor ;		
		3	receptor on (cell surface) membrane (of B lymphocyte) ;		**3 DO NOT CREDIT** 'antibodies' (on cell surface)
		4	(receptor and cytokine have) complementary shapes ;		
		5	activates / stimulates, clonal expansion / mitosis ;	3 max	**5 ACCEPT** activates / releases 2nd messenger
			Total	**13**	

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Question			Expected Answer	Mark	Additional Guidance
2	(a)	(i)	blue-black / black / dark blue ;	1	**ACCEPT** dark purple / purplish-blue **DO NOT CREDIT** blue or purple unqualified by darkness **ACCEPT** acceptable colour change
2	(a)	(ii)		2	**CREDIT** marking points from clearly labelled diagram max 1 if incorrect charges are on atoms
		1	between oxygen and hydrogen (atoms) ;		**1 DO NOT CREDIT** molecules / ions
		2	(between) electronegative / δ^-, and electropositive / δ^+ ;		**2 DO NOT CREDIT** ions / + and – **2 ACCEPT** slight / partial (negative / positive), charge
2	(a)	(iii)		2 max	**IGNORE** refs to denaturation
		1	hydrogen / H, bonds break ;		
		2	helix, lost / unravels / AW ;		**2 ACCEPT** spiral / coil
		3	iodine, released / no longer in complex / AW ;		**3 ACCEPT** no longer contained in helix

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Question			Expected Answer	Mark	Additional Guidance
2	(b)	1	take samples at a range of times / AW ;		
		B2	same volumes (of solutions) added / removed (each time) ;		**B2** must be in context of Benedict's test rather than reaction mixture
		B3	heat with, Benedict's (solution) / $CuSO_4$ and NaOH ;		**B3 DO NOT CREDIT** boil / warm **B3 DO NOT CREDIT** if Benedict's added to the mixture at the beginning
		B4	(use of) excess Benedict's ;		
		B5	changes to, green / yellow / orange / brown / (brick) red ;		
		C6	remove precipitate / obtain filtrate ;		**C6 CREDIT** description of method e.g. filtering / centrifuging / decanting
		C7	colorimeter ;		
		8	calibrate / zero, using, a blank / water / (unreacted) Benedict's ;		**8 IGNORE** 'control'
		9	use (red / orange) filter ;		**9 DO NOT CREDIT** if colour of filter is incorrect
		T10	reading of, transmission / absorbance **OR** mass of precipitate ;		**T10 ACCEPT** 'measure how much light, does / does not, pass through'
		11	more transmission / less absorbance, of filtrate, **OR** greater mass ppt, = more maltose present ; **ora**		**11** if unfiltered Benedict's / precipitate is **clearly indicated** as being present **in sample**, **ACCEPT** 'less transmission / more absorbance, = more maltose present' **11 DO NOT CREDIT** if precipitate is added to colorimeter
		12	using, standard / known, concentrations (of maltose) ;		**12 CREDIT** 'serial dilutions'
		13	(obtain) calibration curve ;		
		14	plot, transmission / absorbance / mass of ppt, against (reducing sugar) concentration ;		
		15	use graph to read off concentration of maltose / AW ;	**6 max**	
			QWC – correct sequence ;	**1**	1 of mps **B2 to B5**, *then* mp **C6 or C7**, *then* mp **T10**

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<table>
<tr><th colspan="3">Question</th><th>Expected Answer</th><th>Mark</th><th>Additional Guidance</th></tr>
<tr><td>2</td><td>(c)</td><td>(i)
1
2

3</td><td>increases / greater / faster ;
reaction completed in / plateaus after / concentration is 100% after, 3.5 minutes ;
figures with units to support mp 1 ;</td><td>2 max</td><td>1 ACCEPT any time between 3.45 and 3.55 min.

3 two maltose concentrations (+ or – chloride) for a given time or two times (+ or – chloride) for given maltose concentration.
3 ACCEPT calculated difference
3 DO NOT CREDIT if ‘%’ and ‘min.’ not given
3 ACCEPT any concentration within ± 1 % and time within ± 0.05 min.</td></tr>
<tr><td></td><td></td><td></td><td colspan="4">
<table>
<tr><th rowspan="2">Presence or absence of chloride ions</th><th colspan="9">The percentage concentration of maltose (%) present every half a minute</th></tr>
<tr><th>0.0 min</th><th>0.5 min</th><th>1.0 min</th><th>1.5 min</th><th>2.0 min</th><th>2.5 min</th><th>3.0 min</th><th>3.5 min</th><th>4.0 min</th></tr>
<tr><td>Chloride ions present</td><td>0</td><td>24</td><td>54</td><td>70</td><td>80</td><td>88</td><td>95</td><td>100</td><td>100</td></tr>
<tr><td>Chloride ions absent</td><td>0</td><td>12</td><td>20</td><td>29</td><td>36</td><td>40</td><td>45</td><td>48</td><td>50</td></tr>
<tr><td>Difference in maltose concentration When chloride ions are either present or absent</td><td>0</td><td>12</td><td>34</td><td>41</td><td>44</td><td>48</td><td>50</td><td>52</td><td>50</td></tr>
</table>
Allow a + /- 1% for any concentration of maltose and a +/- 2% for the difference in maltose concentrations
</td></tr>
<tr><td>2</td><td>(c)</td><td>(ii)
1

2

3</td><td>(acts as a) cofactor ;

(Cl^-) binds to, enzyme / amylase / amylose / substrate ;

enzyme substrate complex / ESC, forms more, easily / quickly ;</td><td>2 max</td><td>1 IGNORE ‘coenzyme’

2 ACCEPT binds to, active site

3 ACCEPT description</td></tr>
</table>

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Question			Expected Answer	Mark	Additional Guidance
2	(c)	(iii)			**Mark the first three answers only regardless of which line they are on** **DO NOT CREDIT** refs to, time
		1	temperature **;**		
		2	pH **;**		
		3	enzyme / amylase / chloride, <u>concentration</u> **;**		**3 IGNORE** 'amount' or 'volume' **3 DO NOT CREDIT** 'concentration' unqualified
		4	substrate / starch / amylose, <u>concentration</u> **;**		**4 IGNORE** 'amount' or 'volume' **4 DO NOT CREDIT** 'concentration' unqualified
		5	constant / regular, stirring **;**		
		6	(fixed) <u>volume</u> of solution (removed each time for sampling) **;**		
				3 max	
			Total	**19**	

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Question			Expected Answer	Mark	Additional Guidance
3	(a)	(i)			**ACCEPT** reference to numbers rather than breeding success throughout
		1	(all), sub-arctic / all 4 named sub-arctic, species / birds, show decrease **;**		**1** sub-arctic species = snow bunting + Lapland bunting + ptarmigan + dotterel
		2	(all / most), other / non sub-arctic / all 4 named non sub-arctic, species / birds, show, increase / no change **;**		**2** non sub-arctic species = red grouse + wheatear + meadow pipit + ring ouzel
		3	greater change / AW (in breeding success), in sub-arctic than in non sub-arctic species **;**		
		4	comparative figs (in 1970 **AND** 2000) **;**		**4** number of young for one sub-arctic and one non sub-arctic species in 1970 and 2000 (or calculated subtraction between the two years) **4 DO NOT CREDIT** if figures are not from 1970 and 2000
				3	

species	number of young raised per year		
	1970	**2000**	**difference in number of young raised between 1970 and 2000**
Snow bunting*	78	2	Down 76
Lapland bunting*	7	0	Down 7
Ptarmigan*	1280	876	Down 404
Red grouse	890	962	Up 72
Wheatear	209	231	Up 22
Meadow pipit	23	82	Up 59
Ring ouzel	23	26	Up 3
Dotterel*	45	35	Down 10

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Question			Expected Answer	Mark	Additional Guidance
3	(a)	(ii)			
		1	climate change / global warming ;		**1 IGNORE** greenhouse effect **1 DO NOT CREDIT** 'it is too warm' or 'it is not cold enough' without reference since 1970
		2	(environmental) change too rapid for adaptation ;		
		3	change in, flora / plants / food supply / insects / prey / predators / human activity ;		**3 ACCEPT** camouflage no longer appropriate / reduction in size of habitats
		4	disease (that affects sub-arctic species more than others) ;		
		5	sub-arctic species, less well-adapted than / have been outcompeted by, non sub-arctic species / AW ;		**5 ACCEPT** ora
				2 max	
3	(b)	(i)	the number of species present (in a habitat) ;	1	**DO NOT CREDIT** range / amount

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Question			Expected Answer	Mark	Additional Guidance
3	(b)	(ii)			**Mark the first <u>three</u> suggestions**
		1	*idea of:* unbiased method to selecting sampling <u>area</u> **;**		**1 ACCEPT** e.g. random selection of, areas / coordinates OR use of transect **1 IGNORE** 'random sampling' unqualified
		2	sample many times / AW, and calculate mean / average **;**		
		3	standardised sweeping procedure **;**		**3** e.g. same type of movement / same length of time same number of sweeps **3 ACCEPT** sample at same time of day **3 IGNORE** same collector **3 IGNORE** refs to using alternative collecting techniques in order to collect more insect species
		4	ensure insects do not escape (before being identified) **;**		**4 ACCEPT** use of pooter
		5	method to prevent recounting **;**		**5** if ref to mark-release-recapture, **IGNORE** 'release and recapture' and look for idea for preventing recounting
		6	sample at different times of, day / month / year / weather conditions **;**	**3 max**	

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Question			Expected Answer	Mark	Additional Guidance
3	(b)	(iii)			
		1	(measures), abundance / numbers, of individuals in each species ;		
		2	species evenness is more quantitative than species richness ; **ora**		
		3	high(er) species evenness indicates high(er) biodiversity ; **ora**		
		4	low species evenness indicates, dominance by / high abundance of, one / few, species ; **ora**		
		5	used to calculate (Simpson's) Index of Diversity ;		
		6	example used to illustrate explanation of mp 3 or 4 ;	3 max	**6** e.g. "Two areas have the same number of species. One with 90% of 1 species has less biodiversity than one where all species have an abundance of 5-20%"
			Total	**12**	

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Question			Expected Answer	Mark	Additional Guidance
4	(a)	1	free from, disease / illness ;		**1 ALLOW** infection **CREDIT** 'not just the absence of disease'
		2	physical **and** mental **and** social wellbeing / AW ;		**2 DO NOT CREDIT** 'state' / 'condition'
		3	good nutrition ;		**3 ACCEPT** balanced diet
		4	suitably housed ;	**2 max**	**4 ACCEPT** ref to economic wellbeing

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Question			Expected Answer	Mark	Additional Guidance
4	(b)				**Mark first F mark on line and assume explanation relates to that** **ACCEPT** named example(s) of pathogen or parasite **CREDIT E** marks if a reasonable, but non-creditworthy, attempt at an **F** mark has been made, e.g. 'lining of nasal passages' for **F2**
		F1	skin ;		
		E1	*idea of:* physical barrier to prevent entry of microorganisms ;		**E1 ACCEPT** 'pathogens cannot pass through cells' **E1 ACCEPT** antibacterial effects of sebum or sweat **E1 DO NOT CREDIT** physical barrier unqualified
		F2	mucous membrane(s) / goblet cells ;		
		E2	(produce) mucus to trap, pathogens / parasite ;		
			OR		
		F2	mucus ;		
		E2	traps pathogens ;		
		F3	cilia / ciliated epithelium ;		
		E3	remove, pathogen / parasite, laden / AW, mucus ;		
		F4	blood clotting ;		
		E4	prevents, pathogens / parasite, entering bloodstream ;		
		F5	ear wax / nasal hairs ;		
		E5	traps, pathogens / parasite ;		
		F6	lysozyme / tears / nasal secretions / saliva ;		**F6 IGNORE** lysosome(s)
		E6	kills bacteria / contains antibacterial agent ;		**E6 ACCEPT** contains antibodies
		F7	gastric juice / stomach acid ;		**F7 ACCEPT** 'enzymes in the stomach' or 'acid in vagina'
		E7	kills, pathogens / parasite ;		
				4 max	

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Question			Expected Answer	Mark	Additional Guidance
4	(c)	(i)			
		1	lives, on / in / in contact with, **and** harms <u>host</u> **;**		**1** living on / in must be stated, cannot be implied from feeding **1 IGNORE** 'live off'
		2	takes nutrition from / feeds on (host) **;**		
		3	warmth **;**		**3 ACCEPT** 'incubate'
		4	protection / safe place / AW **;**		
		5	allows transmission / spread, to a new host / AW **;**		**5 ACCEPT** 'distributed' / 'passed on' as implies new host
				4 max	
4	(c)	(ii)			
		1	wash / clean / disinfect / sterilize, hands **;**		
		2	not, scratching / touching, of anus **;**		**2 ACCEPT** method to prevent scratching e.g. cutting nails **2 IGNORE** 'wash anus'
		3	drugs to, kill / remove, parasite / eggs **;**		**3 DO NOT CREDIT** 'antibiotics' **3 IGNORE** 'anti-bacterial'
				2 max	
			Total	**12**	

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Question			Expected Answer	Mark	Additional Guidance
5	(a)			6	**Award** 1 mark for each correct row **DO NOT CREDIT** if more than one letter in a box

statement	DNA only (**D**) or RNA only (**R**) or both DNA and RNA (**B**)	
contains thymine	**D**	
contains ribose	**R**	;
consists of 2 chains connected to each other with hydrogen bonds	**D**	;
has a sugar-phosphate backbone	**B**	;
has 4 different nitrogenous bases	**B**	;
contains a pentose sugar	**B**	;
is found in the nucleus and cytoplasm	**R**	;

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Question			Expected Answer	Mark	Additional Guidance
5	(b)	(i)			
		1	(information used to) decide which, group / taxon, organism / species / named example, fits in ;		**1** answers must refer to the information provided by the study of DNA, rather than simply the job of taxonomists**,** e.g. **ACCEPT** 'it can be used to put organisms into groups' **1 IGNORE** 'for classification' unqualified – look for idea of: groups **1 CREDIT** ref to belonging to same taxonomic group, e.g. 'to see if it belongs in the genus *Homo*'
		2	compare the proportion of (different) bases ;		**2 IGNORE** 'examine proportion of bases' **2 CREDIT** idea for looking at similarities / differences
		3	compare the DNA / genes / sequence of bases ;		**3 IGNORE** 'examine sequence of bases' **3 CREDIT** idea for looking at similarities / differences
		4	*idea of:* the more similar the, DNA / genes, the closer the relationship / AW ;	**2 max**	**4** Must contain reference to similarity of DNA
5	(b)	(ii)			**Mark the first <u>two</u> suggestions** **IGNORE** ref to genetics as DNA is 'biochemical'
		1	fossil record ;		
		2	anatomy / physiology / behaviour ;		**2 ACCEPT** AW for anatomy, e.g. observable / physical features / cell structure **2 ACCEPT** AW for physiology, e.g. method of reproduction
		3	embryology / AW ;	**2 max**	
5	(c)		**J** ; **T** ;	**2**	**DO NOT CREDIT** names

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Question			Expected Answer	Mark	Additional Guidance
5	(d)	(i)			
		1	no DNA from living specimens in Wales analysed ;		
		2	population (may have) evolved / mutations have occurred / genetic variation, (since 1948) ;	1 max	**2 ACCEPT** description of evolved **2 DO NOT CREDIT** 'evolution' unqualified by context of pine marten population
5	(d)	(ii)			**ACCEPT** animals as AW for pine martens throughout answer
		1	(introduced) pine martens might not be adapted to local conditions / AW ;		**1 ACCEPT** not adapted to the habitat **1 DO NOT CREDIT** 'used to'
		2	(local) habitat, might have changed / is no longer suitable (for any pine martens) / AW ;		
		3	introduced, pine martens, might outcompete native, population / pine martens ;		**3 ACCEPT** introduced pine martens might kill native / Welsh pine martens **3 IGNORE** 'compete' unqualified
		4	introduced pine martens might bring disease ;		
		5	Welsh pine marten would lose its, distinctiveness / identity, because of interbreeding ;	1 max	
			Total	**14**	

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Question			Expected Answer	Mark	Additional Guidance
6	(a)	(i)	genes / genetic / mutation ; environment(al) ;	2	**Mark the first answer on each line** **IGNORE** inherited / DNA
6	(a)	(ii) 1 2 3 4	no defined categories ; range of values / intermediate values ; influenced by, environment / many genes / genes and environment ; quantitative / has to be measured / cannot be counted ;	3 max	**2 ACCEPT** ref to bell-shaped curve / binomial distribution **3 ACCEPT** any ref to 3 or more genes **4 ACCEPT** metric
6	(a)	(iii)	B ;	1	**DO NOT CREDIT** if more than one letter is given
6	(a)	(iv) 1 2 3 4	growth too rapid ; increased susceptibility to, disease / named abnormality ; inbreeding ; reduces gene pool / genetic variation / genetic diversity ;	2 max	**2** e.g. bone / skeletal abnormalities or low immunity **3 DO NOT CREDIT** if implies inbreeding causes mutations **4 IGNORE** refs to biodiversity

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Question			Expected Answer	Mark	Additional Guidance
6	(a)	(v)			
		1	maintain biodiversity ;		
		2	aesthetic (reasons) / tourism ;		
		3	ethical (reasons) ;		**3 ACCEPT** religious
		4	part of a food chain / web ;		**4 ACCEPT** food source for local population
		5	maintain / increase gene pool ;		
		6	genetic resource / availability to breed with domestic chickens ;		**6 CREDIT** description, e.g. 'source of desirable genes' or 'source of genetic variation' **6 ACCEPT** specific example of genetic resource e.g. disease resistance / strong bones / longevity / heat tolerance / idea of domesticating wild population
				2 max	

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Question			Expected Answer	Mark	Additional Guidance
6	(b)	(i)			**Mark the first two answers only**
		1	reduces / prevents (infectious) disease **;**		**1 IGNORE** illness
		2	prevent, problems / named problem, with gut **;**		**2** e.g. diarrhoea
		3	digest food more, efficiently / easily / quickly **;**		
		4	greater proportion of, food / energy, can contribute to growth **;**		**4 ACCEPT** faster growth as AW for contribute to growth **4 IGNORE** larger chickens
		5	reduce risk of transmitting, pathogens / named pathogen, to humans **;**	**2 max**	**5 ACCEPT** 'meat less likely to be infected with bacteria'
6	(b)	(ii)			
		1	(antibiotic) resistant, pathogens / bacteria **;**		**1 ACCEPT** microorganisms / microbes **1 IGNORE** germs **1 DO NOT CREDIT** immune
		2	antibiotics kill useful, bacteria **;**		**2 DO NOT CREDIT** if any ref to viruses
		3	*idea of:* antibiotic passing into human food **;**	**1 max**	
			Total	**13**	

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Question			Expected Answer	Mark	Additional Guidance
7	(a)				**CREDIT** marking points from a clearly labelled diagram
		1	sequence / chain, of amino acids **;**		**1 IGNORE** polypeptide
		2	(amino acids) joined by peptide bonds **;**		
			secondary		
		S1	alpha / α, helix **;**		
		S2	small regions of, beta / β, pleated sheet / fold **;**		
		S3	hydrogen / H, bonds **;**		**S3** Must be in context of secondary structure
			tertiary		
		T1	secondary structure / helix / polypeptide chain, undergoes further, coiling / folding **;**		**T1 ACCEPT** polypeptide chain folds further
		T2	*3 bonds / interactions from:* disulfide / ionic / hydrogen / hydrophobic or hydrophilic **;**		**T2 IGNORE** if clearly in context of secondary or quaternary structures **T2** H bond must be in context of tertiary structure
		T3	hydrophilic R groups on outside (of molecule) / hydrophobic R groups on inside (of molecule) **;**		
			quaternary		
		Q1	4, polypeptides / subunits **;**		
		Q2	2, alpha / α, chains **and** 2, beta / β, chains **;**		'contains 2 α and 2 β polypeptides' = 2 marks (Q1 and Q2)
		Q3	1 haem (group) per polypeptide / 4 haems (per molecule) **;**		**Q3 IGNORE** protein in ref to 1 haem (group) per polypeptide
		3	prosthetic group (is) haem, (which) contains Fe^{2+} **;**		**3 ACCEPT** iron ion / Fe^{+} / Fe^{3+} **3 DO NOT CREDIT** iron / Fe unqualified
				6 max	
			QWC - correct refs to secondary, tertiary and quaternary structure **;**	**1**	1 **S** mark and 1 **T** mark and 1 **Q** mark

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Question			Expected Answer	Mark	Additional Guidance
7	(b)				Assume answer refers to collagen unless stated If the answer mentions only collagen, assume that the candidate thinks any features mentioned also apply to haemoglobin.
			(collagen has)		
		1	amino acid, chain / sequence ;		**1 IGNORE** polypeptide **1 IGNORE** repeating units
		2	peptide bonds ;		
		3	helical / helix ;		**3 DO NOT CREDIT** if candidate refers to collagen having an α helix
		4	*3 bonds / interactions from:* disulfide / ionic / hydrogen / hydrophobic or hydrophilic ;		
		5	quaternary structure ;		**5 IGNORE** primary /secondary / tertiary
		6	more than one polypeptide / subunit ;		**6 ACCEPT** polypeptides but **DO NOT CREDIT** 3 polypeptides if number in haemoglobin not specified
				4 max	
			Total	**11**	

Question			Expected Answer	Mark	Additional Guidance
8		1	antibodies ;		**ACCEPT** minor mis-spellings so long as word can not be confused with another word in the list
		2	natural ;		
		3	artificial ;		
		4	natural ;		
		5	antigen ;		
		6	vaccination ;	**6**	
			Total	**6**	

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ADVANCED SUBSIDIARY GCE
BIOLOGY
Molecules, Biodiversity, Food and Health

F212

Candidates answer on the Question Paper

OCR Supplied Materials:
- Insert (inserted)

Other Materials Required:
- Electronic calculator
- Ruler (cm/mm)

Tuesday 8 June 2010
Morning

Duration: 1 hour 45 minutes

OCE/16440

F 2 1 2

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your Candidate Number, Centre Number and question number(s).

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **100**.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.
-  Where you see this icon you will be awarded marks for the quality of written communication in your answer.
- This document consists of **24** pages. Any blank pages are indicated.

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Answer **all** the questions.

1 **(a)** Milk is considered to be a complete food containing most of the components of a balanced diet.

A student carried out a series of food tests on a sample of milk. The student's observations and conclusions are shown in Table 1.1.

(i) Complete Table 1.1 by

- naming the molecule being tested for
- stating whether this molecule is present or absent.

The first row has been completed for you.

Table 1.1

reagent	observation	molecule being tested for	present or absent
ethanol and water	white emulsion	lipid	present
Benedict's solution	brick-red precipitate		
biuret I and II	lilac colour		
iodine solution	yellow / brown		

[3]

(ii) Although the student entered 'present' for lipid in the first row of the table, he was unsure whether the result was correct.

Suggest why the student was unsure if the positive result for lipid was correct for the milk sample.

.....

.....

..... **[1]**

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(iii) Triglycerides are a type of lipid found in milk.

Describe the structure of a triglyceride molecule.

.....

.....

.....

.....

.....

.....

..... **[3]**

(b) State **three** roles of lipids in living organisms.

1 .....

.....

2 .....

.....

3 .....

..... **[3]**

(c) Human populations with diets high in animal fats have a lower life expectancy than those with diets high in vegetable oils.

(i) Suggest **one** difference between lipids from animals and those from plants.

.....

..... **[1]**

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Animal fats are thought to raise blood cholesterol levels. High blood cholesterol levels can lead to premature death.

Fig. 1.1 shows the relationship between blood cholesterol level and annual death rate per 10 000 of the population.

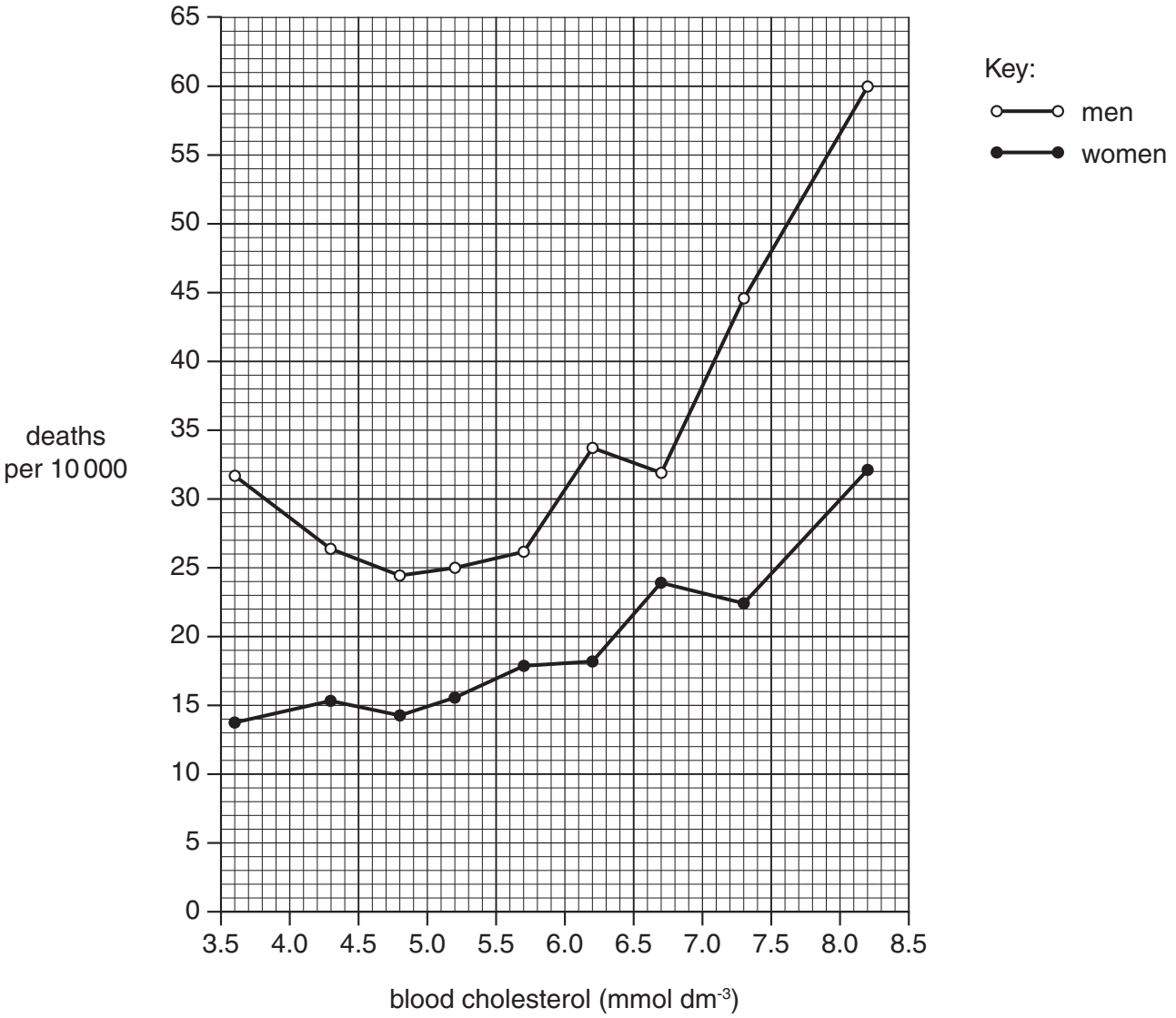


Fig. 1.1

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(ii) Describe the trends shown in Fig. 1.1.

.....

.....

.....

.....

.....

.....

..... **[3]**

(iii) Increased blood cholesterol levels are associated with certain medical conditions.

Suggest **two** medical conditions that may be associated with increased blood cholesterol levels.

.....

..... **[2]**

[Total: 16]

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2 When a new species is discovered, it needs to be classified.

(a) Define the term *classification.*

.....

.....

.....

.....

..... **[2]**

(b) **(i)** Suggest what criteria a taxonomist may take into account when classifying a new species.

.....

.....

.....

.....

.....

.....

.....

..... **[3]**

(ii) Table 2.1 shows the main taxonomic groups. The groups are **not** in the correct order.

Table 2.1

	Q	**R**	**S**	**T**	**U**	**V**	**W**
taxonomic group	species	order	class	phylum	genus	kingdom	family

Place the **letters** representing the taxonomic groups into the correct order.

The first one has been done for you.

V .... **[3]**

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(c) The classification of organisms into domains is relatively new.

Describe the differences between a classification system based on domains and one based on kingdoms.

.....

.....

.....

.....

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.....

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.....

..... **[4]**

[Total: 12]

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3 **(a)** In Scotland, in 2007, there was a major food poisoning outbreak that killed three people.

Suggest **one** group in the population that is more likely to die from food poisoning **and** give a reason for your suggestion.

group .....

reason .....

..... **[2]**

(b) The food poisoning outbreak involved the bacterium *Escherichia coli* 0157 (*E. coli* 0157) which had been responsible for contaminating meat products. The meat had been stored at 11 °C rather than the recommended 5 °C and this led to meat spoilage.

(i) Explain how bacteria cause food spoilage.

.....

.....

.....

.....

.....

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.....

.....

..... **[3]**

(ii) Food normally spoils much faster if stored at temperatures higher than 5 °C.

Explain why food spoils faster at higher temperatures.

.....

.....

.....

.....

.....

.....

.....

.....

..... **[3]**

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(iii) Food can be preserved by keeping it at low temperature in a refrigerator or freezer.

Name **two other** methods of food preservation and state how each method works.

method .....

.....

how the method works .....

.....

.....

method .....

.....

how the method works .....

.....

..... **[4]**

QUESTION 3(c) STARTS ON PAGE 10

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(c) Microorganisms, such as the fungus *Fusarium*, can be grown and then purified to produce mycoprotein. This mycoprotein can be used as a food source for humans.

Table 3.1 compares mycoprotein with beef.

Table 3.1

food	content per 100g					
	energy (kJ)	protein (g)	carbohydrate (g)	total fat (g)	saturated fat (g)	iron (mg)
mycoprotein	357	12	9	2.9	0.6	0.1
beef	1163	26	0	18.2	7.0	2.6

Use the data in Table 3.1 to **describe and explain** the advantages and disadvantages of using microorganisms to produce food for human consumption.



In your answer you should make comparisons using the information in Table 3.1.

advantages .....

.....

.....

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.....

.....

.....

.....

disadvantages .....

.....

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.....

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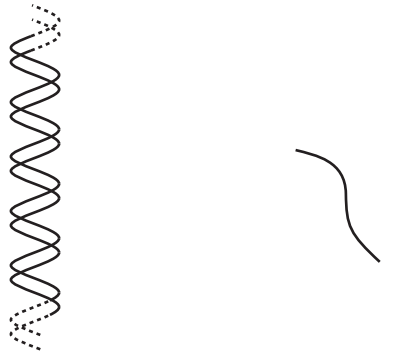
.....

..... **[8]**

[Total: 20]

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4 **(a)** Fig. 4.1 is a drawing that represents molecules of DNA and messenger RNA (mRNA).



DNA **mRNA**

Fig. 4.1

The mRNA molecule is shorter than the DNA molecule.

(i) State, using **only** the information in Fig. 4.1, **one other** way to distinguish between DNA and mRNA.

.....

..... **[1]**

(ii) Give **one** further difference in **structure** between DNA and RNA.

.....

..... **[1]**

DNA and mRNA are both involved in protein synthesis. The mRNA molecule, carrying the code for protein, leaves the nucleus and attaches to a ribosome. The ribosome is the site where a protein molecule is formed.

(iii) Complete the following statement:

A sequence of DNA nucleotides that codes for a protein is a ..... **[1]**

(iv) Suggest why DNA is not able to leave the nucleus.

.....

.....

..... **[1]**

(v) Explain why the mRNA molecule is shorter than a DNA molecule.

.....

.....

.....

.....

..... **[2]**

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(b) Enzymes are involved in the production of mRNA in eukaryotic cells. One enzyme is inhibited by the toxin, α-amanitin.

Fig. 4.2 shows the effect when α-amanitin attaches to this enzyme.

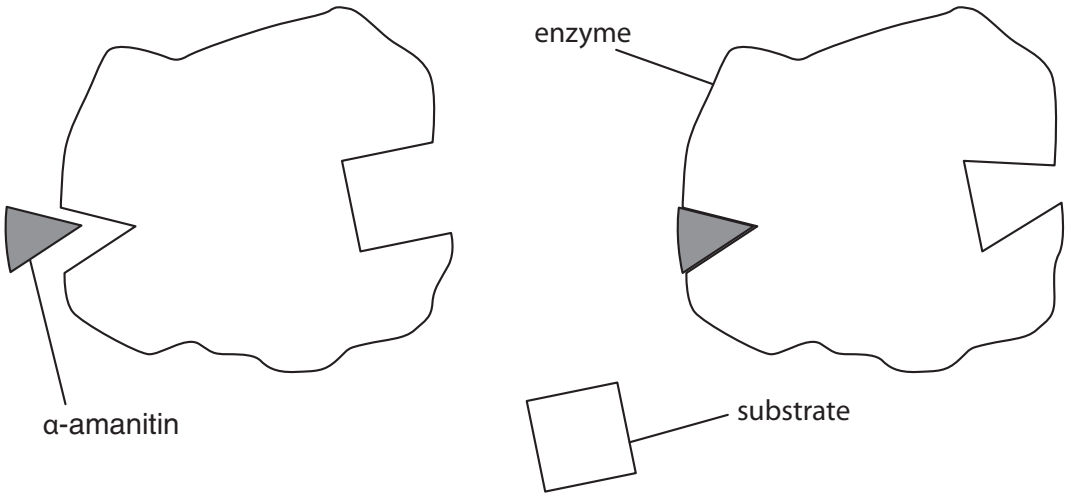


Fig. 4.2

(i) Explain how α-amanitin stops the formation of an enzyme-substrate complex during RNA production.

.....

.....

.....

.....

.....

..... **[2]**

(ii) The Roman Emperor Claudius was poisoned by his wife Agrippina when she gave him death cap fungus to eat. The death cap fungus contains α-amanitin.

Suggest how the toxin α-amanitin may lead to the death of an organism.

.....

.....

.....

.....

.....

..... **[2]**

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(c) (i) Enzymes are globular proteins with a specific three dimensional shape. The shape is determined by the primary structure.

State the meaning of the term *primary structure*.

.....

..... **[1]**

Fig. 4.3 shows some of the chemical bonds that hold the **tertiary** structure of a protein together.

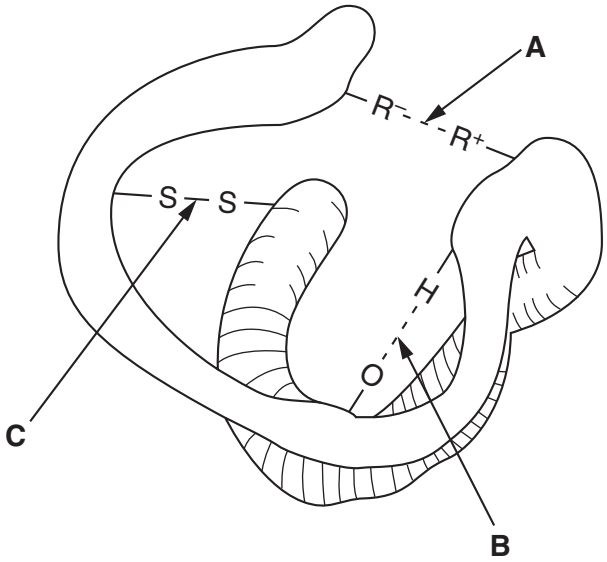


Fig. 4.3

(ii) Name the bonds labelled **A**, **B** and **C**.

A.....

B.....

C .....

[3]

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(d) When proteins are heated to a high temperature, their tertiary structure is disrupted.

Explain how this occurs.

.....

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.....

..... **[3]**

[Total: 17]

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5 **(a)** Smoking increases the risk of lung infections.

(i) Explain how the mucus and the cilia in the air passages reduce the chance of developing lung infections.

.....

.....

.....

.....

.....

..... **[2]**

QUESTION 5 CONTINUES ON PAGE 16

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In an individual with bronchitis, the mucus contains a large number of pathogenic bacteria. Phagocytic white blood cells destroy the bacteria.

Fig. 5.1 shows the sequence of events that results in the destruction of a bacterium.

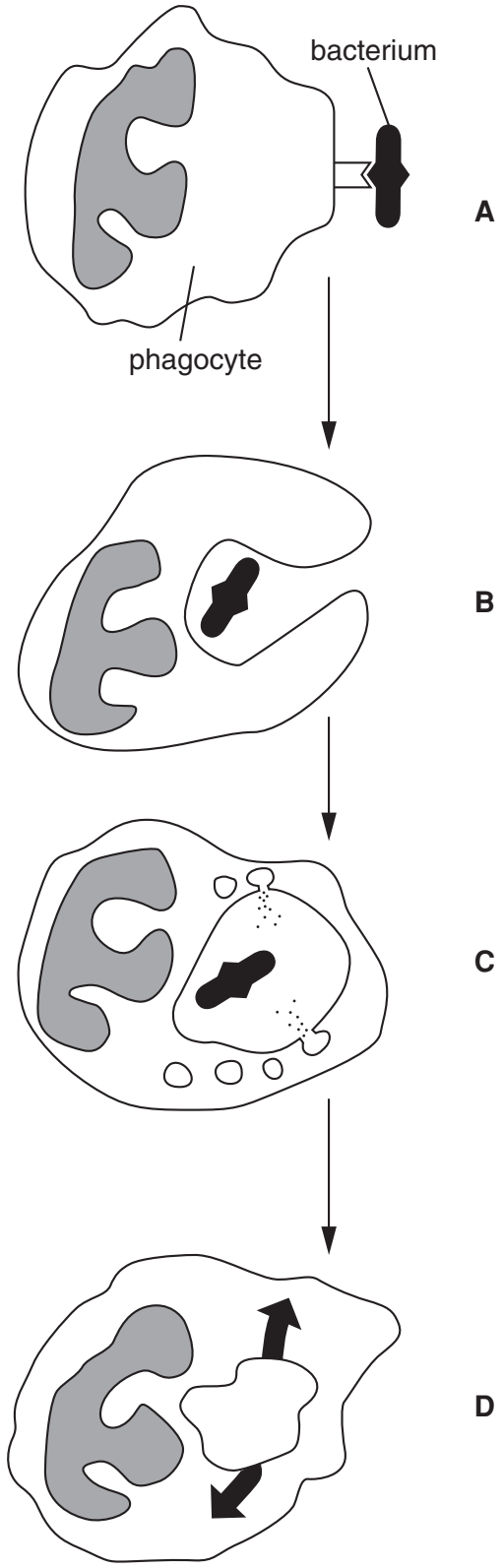


Fig. 5.1

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(ii) Describe the events taking place at stages **A**, **B**, **C** and **D**, in sequence.

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..... **[6]**

(b) The immune system will produce specific antibodies in response to infection.

(i) Name the type of cell that produces antibodies.

..... **[1]**

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(ii) Describe how the structure of an antibody molecule is related to its function.

In your answer you must clearly link structure and function.

.... **[7]**

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(iii) Identify the type of immunity provided by antibodies in breast milk.

Place a tick (✓) in the correct box.

type of immunity

artificial active	
artificial passive	
natural active	
natural passive	

[1]

[Total: 17]

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PLEASE DO NOT WRITE ON THIS PAGE

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6 **(a)** Before any major development can take place, an Environmental Impact Assessment (EIA) needs to be carried out.

One such development is the proposed extension to the M27 motorway in Hampshire. This extension would cut through an important heathland ecosystem.

Suggest **three** aspects of this development that would need to be considered when carrying out the EIA.

.....

.....

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.....

..... **[3]**

(b) An ecologist carried out a survey of butterfly species on the heathland.

The ecologist walked along a marked path on four different days in June. She counted

- the number of butterfly species
- the number of individual butterflies of each species.

(i) Suggest how this method of collecting data could be improved.

.....

.....

.....

.....

.....

.....

.....

..... **[3]**

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(ii) The ecologist's results are shown in Table 6.1.

These results can be used to calculate the Simpson's Index of Diversity (D) for butterflies in this heathland using the formula:

$$D = 1 - [\Sigma (n/N)^2]$$

where n = number of individuals of a species in the sample
N = total number of individuals of all species in the sample

Complete the table by filling in the **three** missing values.

Table 6.1

species	n	n/N	$(n/N)^2$
Grayling (*Hipparchia semele*)	3	0.0968	0.09370
Large Heath (*Coenonympha tullia*)	11	.....	0.12588
Gatekeeper (*Pyronia tithonus*)	6	0.1935	0.03744
Green Hairstreak (*Callophrys rubi*)	2	0.0645	0.00416
Silver-studded Blue (*Plebeius argus*)	2	0.0645	0.00416
Small Heath (*Coenonympha pamphilus*)	7	0.2258	0.05099
		Sum (Σ)	.....
		$1 - \Sigma$	D = ...

[3]

(iii) Suggest the implications of a high value of Simpson's Index of Diversity on planning decisions.

.....

.....

.....

.....

..... **[2]**

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(c) (i) The six species of butterfly identified by the ecologist in the survey are shown **on the insert** in Fig. 6.1.

The ecologist used a dichotomous key to identify these butterflies. This key is shown below:

Key:

Question 1	Round spots on the under wing	yes	go to question 2
		no	go to question 4
Question 2	Orange upper wing	yes	go to question 3
		no	**Silver-studded Blue**
Question 3	One spot on upper wing	yes	**Gatekeeper**
		no	**Large Heath**
Question 4	Spots on upper wing	yes	go to 5
		no	**Green Hairstreak**
Question 5	One spot on upper wing	yes	**Small Heath**
		no	**Grayling**

Identify the butterflies shown in Fig. 6.1 using the key.

Complete Table 6.2 below. One butterfly has been identified for you.

Table 6.2

species	letter
Grayling (*Hipparchia semele*)	
Large Heath (*Coenonympha tullia*)	
Gatekeeper (*Pyronia tithonus*)	
Green Hairstreak (*Callophrys rubi*)	
Silver-studded Blue (*Plebeius argus*)	
Small Heath (*Coenonympha pamphilus*)	E

[5]

QUESTION 6(c)(ii) STARTS ON PAGE 24

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(ii) State why Small Heath and Large Heath butterflies both share part of their scientific name.

.....

.....

.....

.....

..... **[2]**

[Total: 18]

END OF QUESTION PAPER

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Molecules, Biodiversity, Food and Health

Mark Scheme for June 2010

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<table>
<tr><th colspan="3">Question</th><th>Expected Answer</th><th>Mark</th><th>Additional Guidance</th></tr>
<tr><td>1</td><td>(a)</td><td>(i)</td><td>
<table>
<tr><th>reagent</th><th>observation</th><th>molecule</th><th>present or absent</th></tr>
<tr><td>ethanol and water</td><td>white emulsion</td><td>lipid</td><td>present</td></tr>
<tr><td>Benedict's solution</td><td>brick-red precipitate</td><td><u>reducing</u> sugar / lactose / glucose / galactose / monosaccharides</td><td>present ;</td></tr>
<tr><td>biuret I and II</td><td>lilac colour</td><td>protein / named milk protein</td><td>present ;</td></tr>
<tr><td>iodine solution</td><td>yellow / brown</td><td>starch / amylose</td><td>absent ;</td></tr>
</table>
</td><td>3</td><td>One mark per correct row.
IGNORE 'yes', 'no' and ticks and crosses
DO NOT CREDIT if anything incorrect is written in any box in the molecule column.
e.g. 'starch or cellulose' = 0 mark

ACCEPT maltose
DO NOT CREDIT sucrose

ACCEPT casein / lactoglobulin / lactalbumin / polypeptide

IGNORE amylopectin</td></tr>
<tr><td>1</td><td>(a)</td><td>(ii)</td><td>milk is already, cloudy / an emulsion / white / AW ;</td><td>1</td><td>ACCEPT idea of difficulty in detecting change because of the appearance of milk</td></tr>
<tr><td>1</td><td>(a)</td><td>(iii)</td><td>(one) glycerol / glyceride ;
3 fatty acids ;

ester bond (between glycerol and fatty acid) ;</td><td>3</td><td>ACCEPT marking points from clearly labelled diagram but DO NOT CREDIT if contradicted in text.
IGNORE individual atoms on diagram and look for correct position of labels
MAX 2 if phosphate group included (as could be confused with phospholipid)

ACCEPT on diagram if 3 shown and at least one labelled
ACCEPT triglycerides are esters</td></tr>
</table>

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Question			Expected Answer	Mark	Additional Guidance
1	(b)				**MARK THE FIRST RESPONSE ON EACH NUMBERED LINE**
		1	(thermal) insulation ;		***1*** **ALLOW** 'warmth'
		2	energy, store / source / release ;		***2*** **CREDIT** answers that refer to the idea of lipid as a respiratory substrate but **DO NOT CREDIT** 'for respiration' unqualified **IGNORE** 'fat contains energy' without further qualification **DO NOT CREDIT** refs to producing energy or to quick energy release **ACCEPT** 'provides energy'
		3	protection ;		
		4	membranes / phospholipid bilayer / control entry and exit into cells ;		***4*** **CREDIT** ref to cholesterol in membranes
		5	(steroid) hormones / named steroid hormone ;		
		6	buoyancy ;		
		7	waterproofing ;		
		8	source of water (from respiration) ;		
		9	(electrical insulation) in myelin / around neurones / around axons / around dendrons ;		***9*** **CREDIT** nerve fibres / saltatory conduction **IGNORE** nerves
		10	aid, absorption / storage / production, of, fat soluble / A / D / E / K, vitamins ;	3	
1	(c)	(i)			Assume answers refer to animal fats unless otherwise stated **ACCEPT** reverse argument **IGNORE** ref to fats and oils (as stated in question)
			saturated ;		
			(fatty acids have) no / fewer, double bonds ;		**ACCEPT** 'fatty acids are not kinked'
			solid at room temperature ;	1 max	**ACCEPT** reasonable temperature quoted

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Question			Expected Answer	Mark	Additional Guidance
1	(c)	(ii)			
		1	(death rate for) men greater (at any concentration) / AW ;		*1* **ACCEPT** ora
		2	(death rates) rise with increasing cholesterol / AW ;		*2* **ACCEPT** 'positive correlation' (between death and cholesterol)
		3	death rate for men, initially / AW, falls ;		*3* **ACCEPT** 4.8 or below as 'initially'.
		4	steep(er) / AW, rise (in, males / both) at higher cholesterol levels ;		*4* Answers must refer to latter part of graph only (5.7 or above). **ACCEPT** difference (between sexes) greater at high concentration
		5	comparative figures with unit for (blood) cholesterol to support any of the above points ;		*5* There are 3 ways of getting this mark: • values for both sexes at single concentration • two values for single sex at two concentrations • subtraction / calculation, that shows comparison **IGNORE** terms like 'about' See table for acceptable examples of x and y values – if intermediate cholesterol values are used, refer to the graph for the data
				3 max	

blood cholesterol (mmol dm^{-3})	deaths per 10 000	
	women	men
3.6	13.2 - 14.1	31.2 - 32.1
4.3	15.0 - 15.9	26.0 - 26.9
4.8	14.0 - 14.9	24.0 - 24.9
5.2	15.1 - 16.0	24.6 - 25.5
5.7	17.4 - 18.3	25.8 - 26.7
6.2	17.8 - 18.7	33.2 - 34.1
6.7	23.5 - 24.3	31.3 - 32.2
7.3	22.0 - 22.9	44.1 - 45.0
8.2	31.7 - 32.6	59.5 - 60.4

Must include (blood) cholesterol units **Any figure within a particular range is acceptable**

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Question			Expected Answer	Mark	Additional Guidance
1	(c)	(iii)			**Mark first two in list**
		1	coronary heart disease / CHD / cardio-vascular diseases / heart attack / cardiac arrest / myocardial infarction / MI / angina ;		*1* **DO NOT CREDIT** heart disease alone or 'conary' **ACCEPT** hypertension / high blood pressure
		2	atherosclerosis / atheroma ;		*2* **DO NOT CREDIT** arteriosclerosis
		3	stroke ;		
		4	Type 2 diabetes ;		
				2	
			Total	**16**	

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Question			Expected Answer	Mark	Additional Guidance
2	(a)		placing, living things / organisms / named organisms, into, groups / categories / taxa / named taxonomic groups ; based on / AW, similarity / difference ;	2	**ACCEPT** 'grouping living things' Look for the idea of similar organisms being placed in the same group or different organisms being placed in different groups
2	(b)	(i)		3 max	**ACCEPT suitable examples for mps 1 to 4**
		1	morphology / anatomy / (observable / physical) features / appearance / AW ;		*1* **CREDIT** cell features e.g. nucleus / membrane-bound organelles / cell wall / prokaryotic-eukaryotic features / unicellular
		2	biochemistry / cytochrome C ;		*2* **CREDIT** component of cell wall
		3	genes / DNA / genetics / RNA ;		*3* **IGNORE** chromosomes
		4	behaviour / physiology / embryology ;		*4* **ACCEPT** 'how they feed' / nutrition / 'how they reproduce'
		5	idea of shared, evolutionary past / phylogeny ;		*5* **ACCEPT** 'how closely related' **IGNORE** refs to interbreeding / fertile offspring
2	(b)	(ii)	T S R W U Q ; ; ;	3	**Mark the order of letters** (ignoring the dotted lines) All 6 in correct order = 3 marks If any incorrect, then credit T S in order at beginning = 1 mark U Q in order at end = 1 mark R before W anywhere in the sequence = 1 mark

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Question			Expected Answer	Mark	Additional Guidance
2	(c)				**ACCEPT phonetic spellings throughout** **ACCEPT** alternative terms for names of kingdoms and domains throughout (e.g. plants / plantae)
		1	3 domains **AND** 5 kingdoms **;**		
		2	domains are, bacteria / eubacteria, **AND**, archaea / archaebacteria, **AND**, eukarya / eukaryotes **;**		***2*** **ACCEPT** 'eukaryota'
		3	kingdoms are prokaryotes **AND** protoctists **AND** fungi **AND** plants **AND** animals **;**		***3*** **DO NOT CREDIT** protists / protozoa
		4	eukaryotes split into different kingdoms / all eukaryotes are in the same domain **;**		
		5	all prokaryotes are in the same kingdom / prokaryotes split into different domains **;**		
		6	domain classification based on, rRNA / ribosomes / RNA polymerase / protein synthesis / enzymes / flagella / membrane structure **;**	**4 max**	***6*** **IGNORE** RNA unqualified **DO NOT CREDIT** other forms of RNA **ACCEPT** any detail of protein synthesis
			Total	**12**	

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Question			Expected Answer	Mark	Additional Guidance
3	(a)		young / elderly / HIV infected / malnourished / post-operative / on immunosuppressants / leukaemia / undergoing cancer treatment / anorexics ; immature / compromised / weak / AW, immune system ;	2	**IGNORE** prompt lines and mark the answer as a whole **ACCEPT** AW for young / elderly etc **IGNORE** 'ill' or 'unfit' **IGNORE** any reference to populations e.g. those living in vicinity of outbreak **ACCEPT** description **ACCEPT** no immunity
3	(b)	(i)			**DO NOT CREDIT** 'mould' – penalise once only
		1	bacteria / (bacterial) cells, divide / increase in number / multiply / reproduce / proliferate / replicate ;		*1* **IGNORE** 'growth' **DO NOT CREDIT** 'mitosis'
		2	(secrete) enzymes / named enzyme ;		*2* **DO NOT CREDIT** excrete Answer should **not** imply intracellular enzymes
		3	food, digested / broken down ;		
		4a	protein / named protein / polypeptides → peptides / amino acids		
			OR		
		4b	fat / triglycerides → fatty acids		*4b* **IGNORE** cholesterol
			OR		
		4c	starch / amylose / glycogen → glucose / sugar ;		*4c* **ACCEPT** other correct carbohydrate breakdown
		5	production / release / excretion / secretion, of, toxins / named toxin / waste products ;		
		6	(causes) change in, appearance / smell / texture / taste ;	3 max	*6* **CREDIT** suitable example e.g. 'goes mushy'

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Question			Expected Answer	Mark	Additional Guidance
3	(b)	(ii)			Idea of 'more' is needed for all marking points but it can be stated once and linked to more than one point. • e.g. 'more bacteria secreting enzymes' = mp 2 and 4 **ACCEPT** converse argument throughout **ACCEPT** 'fungi' / 'mould' in place of bacteria as question stem does not specify
		1	bacteria, reproduce / AW, more rapidly / faster **;**		***1*** **IGNORE** 'grow' **IGNORE** 'more easily' or 'effectively' **DO NOT CREDIT** if the candidate thinks there is no reproduction at 5°C
		2	(so) more bacteria present **;**		
		3	more, toxins / waste, produced / released / AW **;**		
		4	more enzymes, secreted / AW **;**		***4*** **DO NOT CREDIT** excreted
		5	enzyme, action faster / works better / more effective, at higher temperatures **;**		***5*** **IGNORE** optimum
		6	(substrate and enzymes have) more kinetic energy **;**		
		7	more, enzyme-substrate complexes / ESC / (successful) collisions between substrate and active site **;**	**3 max**	

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Question			Expected Answer	Mark	Additional Guidance
3	(b)	(iii)	max 2 for 2 distinct methods max 2 for 2 **correctly linked** explanations Only credit the explanation mark if the method mark has been awarded.		Where more than one method is given, mark first on line and assume explanation linked with that **DO NOT CREDIT** chilling or freezing (as in question)
		M1 **E1**	salting **;** lack of <u>water</u> due to, osmosis / low water potential (outside cell) **;**		***M1*** **IGNORE** drying ***E1*** **ALLOW** low Ψ / high solute potential
		M2 **E2**	sugar **;** lack of <u>water</u> due to, osmosis / low water potential (outside cell) **;**		***M2*** **IGNORE** drying ***E2*** **ALLOW** low Ψ / high solute potential
		M3 **E3**	(air / freeze) drying **;** *idea that* enzymes cannot mobilise / intracellular transport impaired / reactions have no medium in which to occur / (microbes) cannot move **;**		
		M4 **E4**	pickling / (use of) vinegar **;** (low pH) denatures / changes tertiary structure of / changes 3D shape of, enzymes / proteins **OR** substrate no longer fits active site / active site shape changes / prevents ESC **;**		***E4*** **DO NOT CREDIT** high pH
		M5 **E5**	heat treatment / cooking **;** denatures / changes tertiary structure of / changes 3D shape of, enzymes / proteins **OR** substrate no longer fits active site / active site shape changes / prevents ESC **;**		***M5*** **ACCEPT** pasteurising **IGNORE** canning for this mp ***E5, E 6 & E7*** **ACCEPT** 'kills bacteria' or 'kills microbes' as a reason supporting heat treatment, irradiation or smoking **only once**
		M6 **E6**	irradiation / UV / gamma rays / X-rays / <u>ionising</u> radiation **;** destroys / damages / changes / mutates, DNA / genes / genetic material **;**		***M6*** **CREDIT** radiation if correctly qualified in explanation
		M7 **E7**	smoking **;** (so exposed to) antibacterial / named antibacterial, chemical(s) **;**		***M7*** **CREDIT** addition of, sulphites / sodium benzoate / alcohol
		M8 **E8**	vacuum packing / canning / bottling **;** microorganisms cannot respire <u>aerobically</u> **;**		***E8*** **IGNORE** 'denaturing' as a consequence of canning / bottling
				4	

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Question			Expected Answer	Mark	Additional Guidance
3	(c)		**This is a QWC question** **Ignore sections and mark as continuous prose**		Assume candidate is talking about mycoprotein unless otherwise stated. **CREDIT** ora for beef throughout. **IGNORE** use of figures alone when awarding mps **1, 3, 6, 7, 9** – look for **descriptive statement**, e.g. • '12 g of protein' = no mark • 'only 12 g protein' = 1 mark (mp 9)
		1	low(er) / less, energy (than beef) **;**		
		2	useful for, slimming / weight control / AW **;**		***2*** **ACCEPT** preventing obesity **ACCEPT '**less energy to burn off *during exercise*' **DO NOT CREDIT** 'burn off' unqualified
		3	low(er) / less, (total) fat **;**		
		4	(very) low / (much) less, saturated fat **;**		
		5	lower, cholesterol **OR** lower risk of, (coronary) heart disease / CHD / cardio-vascular diseases / heart attack / cardiac arrest / myocardial infarction / MI / angina / atherosclerosis / atheroma **/** stroke / hypertension **;**		
		6	contains carbohydrate / AW **;**		***6*** **ACCEPT** 'more carbohydrate than beef' **IGNORE** 'carbs'
		7	low(er) / less, iron content **;**		
		8	(increased risk of) anaemia / fewer RBCs / less haemoglobin / reduced oxygen carrying capacity of blood **;**		***8*** **IGNORE** answers phrased in terms of role of iron alone e.g. 'haemoglobin contains iron' = 0 Answers must show consequence of deficiency e.g. 'less haemoglobin' = 1
		9	low(er) / less, protein **;**		
		10	(mycoprotein provides) more balanced diet **;**		
		11	need larger intake to meet requirements / AW **;**	**7 max**	
			QWC – award for 2 clear references to the table **;**	**1**	Award for 2 sets of comparative figures (stated or calculated) with units – 'content per 100g' not needed **IGNORE** vague terms like 'about' as long as figs are correct
			Total	**20**	

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Question			Expected Answer	Mark	Additional Guidance
4	(a)	(i)	1 (m)RNA is single stranded / DNA is double stranded ; 2 (m)RNA is non helical / DNA is helical ;	1	**Mark the first response** but do not award the mark if a further answer is incorrect or contradictory **DO NOT CREDIT** refs to length as given in stem *1* **ACCEPT** DNA is a double helix (as stranded is implied) **for this mp** **DO NOT CREDIT** DNA is a double *molecule* *2* **ACCEPT** (mRNA) not twisted / not coiled / not spiral / straight / ora
4	(a)	(ii)	1 RNA contains ribose **and** DNA contains deoxyribose ; 2 RNA contains, uracil / U, **and** DNA contains, thymine / T ; 3 3 / more than 1, forms of RNA ; 4 RNA is, single stranded / non helical, **and** DNA is, double stranded / helical ; *if not already **awarded** as answer in (i)*	1	**Mark the first response to (a)(ii)** – but but do not award the mark if a further answer is incorrect or contradictory *2* **DO NOT CREDIT** thyamine *3* **ACCEPT** 'one form of DNA'
4	(a)	(iii)	gene ;	1	**IGNORE** allele / operon
4	(a)	(iv)	too big to / does not, fit through pore (in nuclear envelope) ;	1	**ACCEPT** 'too long to fit … pore'
4	(a)	(v)	*idea that* only copies one, gene / section / part / AW, (of DNA) ; *idea that* DNA comprises many, genes / alleles ;	2	e.g. mRNA only codes for 1 protein **DO NOT CREDIT** '1 DNA molecule contains *all* the genes' 'mRNA only codes for 1 protein but DNA codes for many proteins' = 2 marks

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Question			Expected Answer	Mark	Additional Guidance
4	(b)	(i)			
		1	non-competitive (inhibitor) ;		
		2	(α-amanitin / inhibitor / toxin) fits into, allosteric site / a place other than active site ;		
		3	active site changes, shape / configuration / conformation / structure ;		3 **ACCEPT** 'distortion of active site'
		4	substrate no longer, fits / complementary to, active site ;	2 max	*4* Mark to be awarded in context of active site (although need not be repeated if stated in mp 3) **IGNORE** ESC
4	(b)	(ii)			
		1	inhibits production of mRNA / mRNA not produced ;		*1* **CREDIT** prevents transcription
		2	prevents protein synthesis / AW ;		*2* **CREDIT** translation
		3	e.g. of, specific named protein / (vital) process, that may be affected ;	2 max	*3* e.g. respiration / photosynthesis (as question refers to 'an organism') / haemoglobin / cytochrome C oxidase
4	(c)	(i)	sequence / order, of amino acids ;	1	**IGNORE** number / organisation
	(c)	(ii)			**ALLOW** phonetic spelling
			A = ionic ;		
			B = hydrogen ;		
			C = disulfide (bond / bridge) ;	3	**DO NOT CREDIT** disulfate
4	(d)	1	increased kinetic energy ;		*1* must contain the idea of more than normal
		2	(any part of protein molecule) vibrates ;		
		3	hydrophilic / hydrophobic / hydrogen / ionic, bonds / interactions, break ;		*3* **IGNORE** Van der Waals **DO NOT CREDIT** if disulfide / covalent / peptide bonds are included
		4	change in, 3D shape / conformation (of protein) ;		*4* **IGNORE** tertiary / structure (as in question) **IGNORE** refs to, active site / enzymes
		5	denatures ;	3 max	
			Total	**17**	

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Question			Expected Answer	Mark	Additional Guidance
5	(a)	(i)	mucus traps, bacteria / microbes / pathogens / microorganisms / viruses / spores **;** cilia, sweep / move / waft, mucus / bacteria / pathogens / microorganisms / viruses / spore, upwards / AW **;**	**2**	For both marking points **ACCEPT** ora for what would happen if they didn't work **IGNORE** ref to dirt / dust / etc **ACCEPT** answers that imply out of airways e.g. to the throat / coughed / swallowed

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Question			Expected Answer	Mark	Additional Guidance
5	(a)	(ii)	*stage A* 1 phagocyte, attaches / binds / AW, to bacterium / pathogen ; 2 receptor (on phagocyte), attaches to / binds to / recognises / AW, antigen (on bacterium) ; *stage B* 3 bacterium, engulfed / enters by endocytosis / enters by phagocytosis / AW ; 4 (formation of) phagosome / phagocytic vacuole ; *stage C* 5 lysosomes, fuse with / join with / move towards (phagosome) ; 6 release / secrete, enzymes / lysins / named enzyme / hydrogen peroxide / free radicals (into phagosome) ; *stage C/D* 7 bacterium, digested / broken down / hydrolysed ; 8 (to) amino acid / sugar / glucose / fatty acid / glycerol ; *stage D* 9 absorbed / AW, into, cytoplasm / cytosol ; 10 by, (facilitated / simple) diffusion / active transport ;	6 max	**IGNORE** stage letters and look for correct sequence **DO NOT CREDIT** steps that are biologically out of sequence, e.g. mp6 before mp5. Penalise once only. **ACCEPT** 'bacteria' throughout *2* **CREDIT** PAMP / antibody marker / complement marker, as AW for antigen *3* **DO NOT CREDIT** 'eaten' **IGNORE** pseudopodia or any other structure *5* **DO NOT CREDIT** 'binds with' *7* **DO NOT CREDIT** destroyed (as in the question) **IGNORE** refs to antigen presentation as this happens after the stage shown in the diagram
5	(b)	(i)	plasma (cell) ;	1	**ACCEPT** B lymphocyte **ACCEPT** effector cell **DO NOT CREDIT** lymphocyte unqualified

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Question			Expected Answer	Mark	Additional Guidance
5	(b)	(ii)	**This is a QWC question**		**CREDIT** a correctly labelled diagram that is clearly an antibody **CON** if diagram and text are contradictory MPs 3, 5, 6, 8, 10 are stand alone but **DO NOT CREDIT** if context is clearly incorrect. e.g. 'constant region gives specificity' **AWARD** mp 2 but not mp 5
		1	Y-shaped molecule / light and heavy chains / disulfide bonds / 4 polypeptide chains **;**		
		2	constant region **;**		
		3	marker for / binds to, phagocytes / AW **;**		***3*** **ACCEPT** ref to opsonisation
		4	variable region **;**		
		5	(antibody) specificity **;**		
		6	(has) complementary shape to antigen (on pathogen) **;**		'Complimentary shape to specific antigen' = 2 marks (mps **5 & 6**)
		7	hinge (region) **;**		
		8	allows flexibility **;**		***8*** **IGNORE** 'movement' unqualified
		9	more than one variable region :		***9*** **DO NOT CREDIT** from diagram unless more than one is explicitly labelled or clearly keyed (e.g. by shading)
		10	allows, agglutination / description of agglutination **or** attachment to more than one, pathogen / antigen **;**		
		11	neutralisation / blocking pathogen's binding sites **;**	**6 max**	***11*** **ACCEPT** ref. to antitoxin
			QWC – award when 2 marks are given in any two of the grouped sections **;**	**1**	2 marks had been awarded from 2 of the following groups of marks (4 marks in total) mps 2 & 3 mps 4 & 5/6 mps 7 & 8 mps 9 & 10

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Question			Expected Answer	Mark	Additional Guidance
5	(b)	(iii)	*type of immunity* *artificial active* ☐ *artificial passive* ☐ *natural active* ☐ *natural passive* ✔ ;	1	**DO NOT CREDIT** if more than 1 box is ticked **DO NOT CREDIT** a cross **DO NOT CREDIT** a tick that has been crossed out and is a 'hybrid' tick
			Total	**17**	

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Question			Expected Answer	Mark	Additional Guidance
6	(a)	1	biodiversity (of heathland) ;	3 max	
		2	rare / endangered, species / plants / animals / fungi / organisms / named organism ;		
		3	rarity of (this) habitat ;		
		4	example of current *legal* status ;		*4* e.g. National Park / SSSI / protected species / National Nature Reserves / NNR / other *legal* example
		5	(likely) reduction in size of, habitat / ecosystem / heathland ;		*5* **IGNORE** 'habitat destruction' alone. Must refer to extent or size of destruction.
		6	effect of reduced size on viability (of whole ecosystem) ;		
		7	effect on, movement / spread, of, species / named species / plants / animals ;		*7* **CREDIT** effect on wildlife corridors Answers could refer to limiting species spread or introduction of species
		8	a method of minimizing impact / AW / named example ;		*8* e.g. 'toad tunnels' / relocation of population 'build toad tunnels so that the toads can still move between the two areas of heathland' = 2 marks (mps 7 and 8)
6	(b)	(i)		3 max	
		1	*idea of* (collect in) different / wider, area ;		*1* **ALLOW** several transects e.g. another path
		2	(collect at) different, times of day / times of year / weather conditions ;		
		3	use of named, collecting / identifying, technique ;		*3* e.g. (sweep) net / photographs / feeding stations **IGNORE** pooter (as could only catch larvae) / light trap / use of key / single transect
		4	method of ensuring that individuals not counted again ;		*4* This mark refers to an initial or the only sample – it is **not** linked to mp 5
		5	mark-release-recapture / capture-recapture, technique ;		*5* **CREDIT** count marked individuals in 2nd sample / population = no. in 1st sample x no. in 2nd sample / no. retrapped in 2nd sample

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<table>
<tr><th colspan="3">Question</th><th>Expected Answer</th><th>Mark</th><th>Additional Guidance</th></tr>
<tr><td>6</td><td>(b)</td><td>(ii)</td><td>
<table>
<tr><th>species</th><th>n</th><th>n/N</th><th>$(n/N)^2$</th></tr>
<tr><td>Grayling (Hipparchia semele)</td><td></td><td></td><td></td></tr>
<tr><td>Large Heath (Coenonympha tullia)</td><td></td><td><u>0.3548</u></td><td></td></tr>
<tr><td>Gatekeeper (Pyronia tythonus)</td><td></td><td></td><td></td></tr>
<tr><td>Green Hairstreak (Callophrys rubi)</td><td></td><td></td><td></td></tr>
<tr><td>Silver-studded Blue (Plebeius argus)</td><td></td><td></td><td></td></tr>
<tr><td>Small Heath (Coenonympha phamhylus)</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>Sum (Σ)</td><td>0.31633 OR 0.31217</td></tr>
<tr><td></td><td></td><td>1 - Σ</td><td>D = 0.68367 OR 0.68783</td></tr>
</table>
;
;
;
</td><td>3</td><td>Original table on question paper had incorrect figure in $(n/N)^2$ column for Grayling row. Answers for mps 2 & 3 take this into account.

ACCEPT ecf from incorrect answer for Σ (whether decimal places or rounding)</td></tr>
<tr><td>6</td><td>(b)</td><td>(iii)</td><td>1 many species present / high species richness / all species evenly represented / high species evenness / high biodiversity ;

2 (so) should not be developed / development should be modified / development should be reconsidered / should be conserved / AW ;</td><td>2</td><td>IGNORE refs to relative robustness of habitat

1 ACCEPT ‘types of butterfly’ as AW for species
IGNORE ‘individuals’ or ‘organisms’

2 DO NOT CREDIT ref to ‘planning’ alone (as given in question)
2 IGNORE responses that imply uncertainty about the development. e.g. ‘could’ ‘might’ ‘may’</td></tr>
</table>

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<table>
<tr><th colspan="3">Question</th><th>Expected Answer</th><th>Mark</th><th>Additional Guidance</th></tr>
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<table>
<tr><th>species</th><th>letter</th></tr>
<tr><td>Grayling (Hipparchia semele)</td><td>A ;</td></tr>
<tr><td>Large Heath (Coenonympha tullia)</td><td>D ;</td></tr>
<tr><td>Gatekeeper (Pyronia tythonus)</td><td>F ;</td></tr>
<tr><td>Green Hairstreak (Callophrys rubi)</td><td>B ;</td></tr>
<tr><td>Silver-studded Blue (Plebeius argus)</td><td>C ;</td></tr>
<tr><td>Small Heath (Coenonympha phamhylus)</td><td>E</td></tr>
</table>
</td><td>5</td><td>DO NOT CREDIT if more than one letter given against any individual species</td></tr>
<tr><td>6</td><td>(c)</td><td>(ii)
1

2

3</td><td>(is) same <u>genus</u> ;

have, features / characteristics / appearance / behaviour / biochemistry / physiology / anatomy / genes / genetic makeup / DNA, that are, similar / in common ;

(share a) common, ancestor / phylogeny ;</td><td>2 max</td><td>1 DO NOT CREDIT vague statements like ‘could be in the same genus’
IGNORE Coenonympha

2 IGNORE ‘similar’ on its own
DO NOT CREDIT ‘same’
IGNORE specific examples (e.g. orange wings / large spot)

3 ACCEPT closely related ;</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>18</td><td></td></tr>
</table>

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THIS IS A NEW SPECIFICATION

OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

BIOLOGY

Molecules, Biodiversity, Food and Health

F212

Candidates answer on the Question Paper

OCR Supplied Materials:
- Insert (inserted)

Other Materials Required:
- Electronic calculator
- Ruler (cm/mm)

Tuesday 12 January 2010
Morning

Duration: 1 hour 45 minutes

OCE/23957

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

MODIFIED LANGUAGE

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **100**.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.
- Where you see this icon you will be awarded a mark for the quality of written communication in your answer.
- This document consists of **28** pages. Any blank pages are indicated.

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Answer **all** the questions.

1 **(a)** A balanced diet is essential for good health.

Complete the following passage by using the most appropriate terms from the list to fill the gaps.

Each term **should not** be used more than once.

haemoglobin **iron** **collagen** **obese**

calcium **anorexic** **sodium**

A balanced diet is one which provides an adequate intake of energy and nutrients for the maintenance of our body. An individual can become ……..... if energy intake exceeds energy usage over a period of time.

The deficiency disease anaemia can be caused by a lack of the mineral ……..... in the diet. As a result of this deficiency, the body is unable to produce sufficient amounts of the protein ……..... in red blood cells. **[3]**

(b) The Body Mass Index (BMI) is one way of determining whether a person is underweight or overweight.

BMI can be calculated using the formula:

$$\text{BMI} = \frac{\text{mass in kg}}{(\text{height in m})^2}$$

Calculate the BMI of a female of mass 69 kg and a height of 1.67 m.

Show your working. Give your answer to **one decimal place**.

Answer = ... **[2]**

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(c) Another way of determining whether a person is underweight or overweight is to use a graph showing the relationship between height and body mass.

Fig. 1.1 is an example of this type of graph.

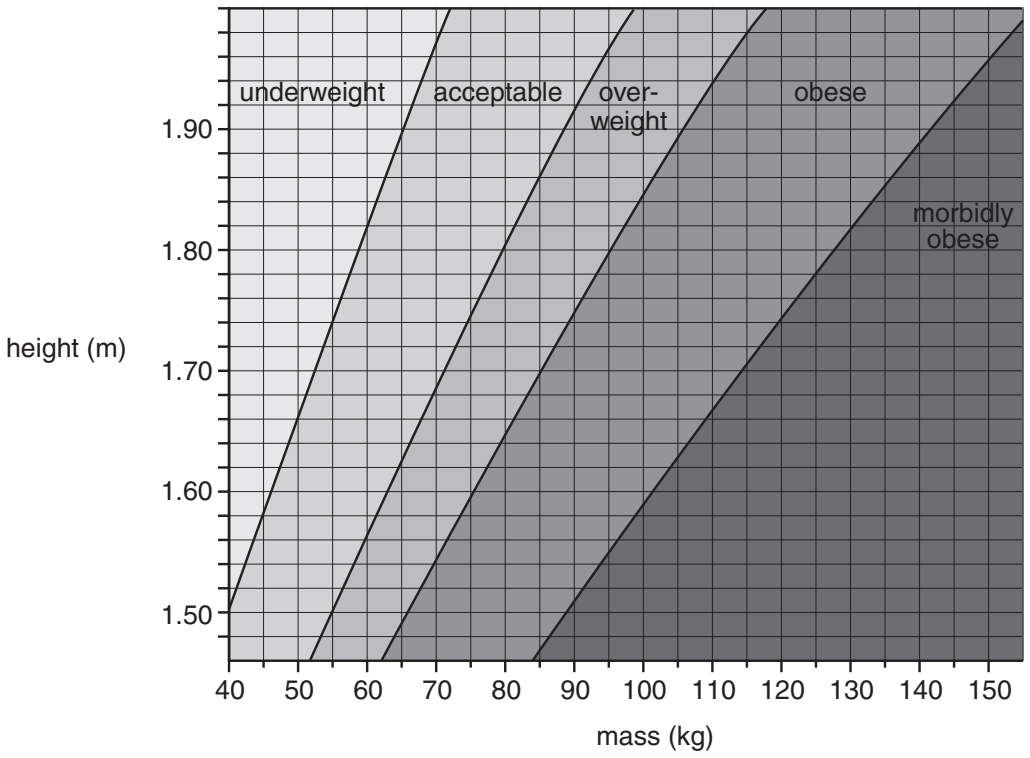


Fig. 1.1

(i) Using Fig. 1.1, state the category into which a female who has a body mass of 69 kg and a height of 1.67 m is placed.

..... **[1]**

(ii) There are many factors that determine the category into which a person is placed. Fig. 1.1 does not take into account all of these factors.

Suggest why the female in **(c)(i)** might be placed in the wrong category.

.....

.....

.....

..... **[2]**

(d) Name **two** diseases associated with obesity.

1 .....

2 ..... **[2]**

[Total: 10]

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2 Fig. 2.1 represents a water molecule.

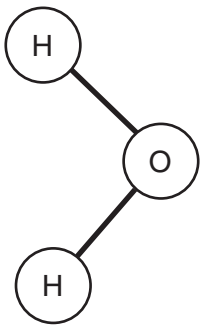


Fig. 2.1

(a) Water molecules are polar. As a result, they attract each other.

Draw a second water molecule on Fig. 2.1.

Your drawing should show:

- the bond(s) between the two molecules
- the name of the bond
- the charges on each atom. **[3]**

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(b) Ponds provide a very stable environment for aquatic organisms.

Three properties of water that contribute to this stability are as follows:

- the density of water decreases as the temperature falls below 4 °C. Therefore, ice floats on the top of the pond
- it acts as a solvent for ions such as nitrates (NO_3^-)
- a large quantity of energy is required to raise the temperature of water by 1 °C.

Explain how these three properties help organisms survive in the pond.



In your answer you should make clear the links between the behaviour of the water molecules and the survival of the organisms.

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..... **[8]**

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(c) Water is important in many biological reactions.

Complete Table 2.1 by writing an appropriate term next to each description.

Table 2.1

description	term
the type of reaction that occurs when water is added to break a bond in a molecule	
the phosphate group of a phospholipid that readily attracts water molecules	

[2]

[Total: 13]

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3 **(a)** The enzyme DHPS is involved in the production of folic acid in bacteria.

- A molecule known as PABA is the substrate for DHPS.
- The enzyme DHPS is inhibited by the drug sulfonamide.

Fig. 3.1 shows the structures of PABA and sulfonamide.

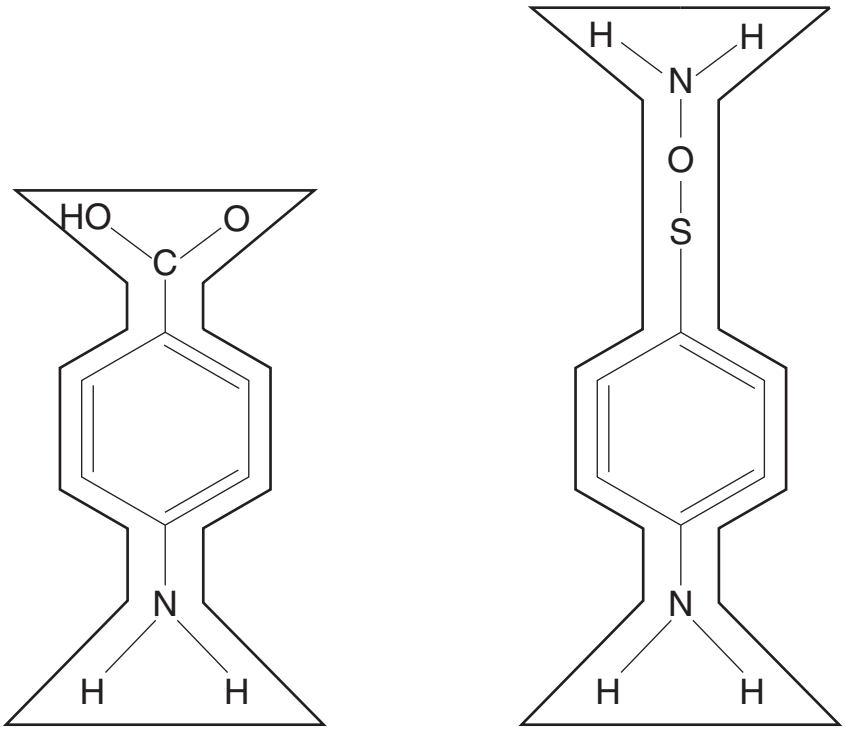
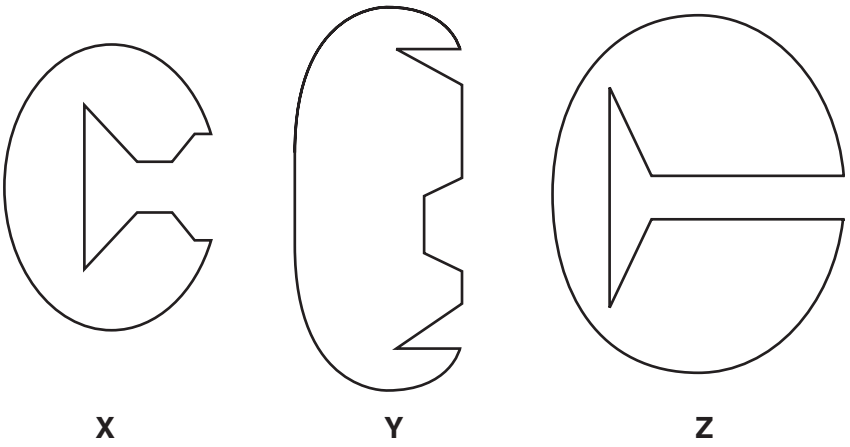


Fig. 3.1

(i) Diagrams **X**, **Y** and **Z** represent these enzyme molecules and their active sites.



State the letter, **X**, **Y** or **Z**, that most accurately represents the enzyme DHPS.

..... **[1]**

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(ii) Use the information in Fig. 3.1 to explain why sulfonamide acts as a competitive inhibitor of DHPS.

.....

.....

.....

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.....

..... **[3]**

QUESTION 3(b) STARTS ON PAGE 10

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(b) Fig. 3.2 shows the effect of increasing the concentration of the substrate (PABA) on the rate of reaction.

- Curve **A** shows the rate of reaction with the competitive inhibitor sulfonamide absent.
- Curve **B** shows the rate of reaction with the competitive inhibitor sulfonamide present.

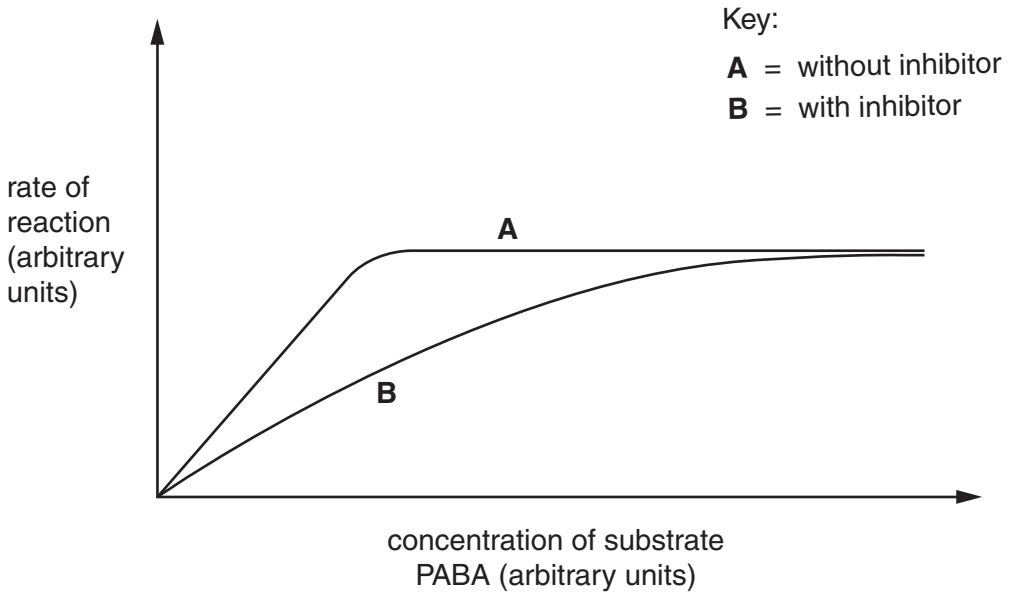


Fig. 3.2

Explain the effect of increasing the concentration of substrate on the rate of reaction;

(i) without inhibitor,

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.....

..... **[3]**

(ii) with inhibitor.

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..... **[2]**

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(c) Antibiotic resistance in bacteria is becoming an increasing problem.

Describe how a sulfonamide-resistant population of bacteria could develop.

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..... **[4]**

QUESTION 3(d) STARTS ON PAGE 12

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(d) Hospitals can use a **multodisc** to check to see if a strain of bacteria causing an infection is resistant to a range of antibiotics. A multodisc contains different antibiotics.

- The bacteria are isolated from a patient.
- The bacteria are spread on nutrient agar in a Petri dish.
- The multodisc is placed on the agar.

Fig. 3.3 shows a Petri dish with the bacteria. A multodisc containing six different antibiotics is placed in the dish.

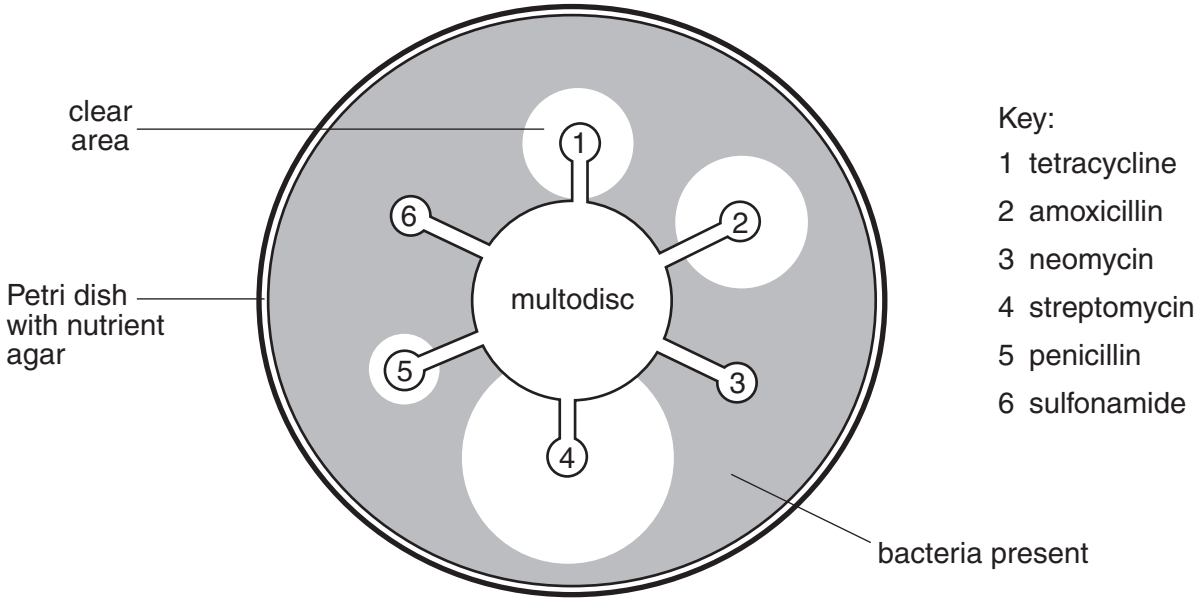


Fig. 3.3

(i) Explain why there are clear areas of agar in the Petri dish.

.....

.....

..... **[1]**

(ii) Using Fig. 3.3, name the antibiotic that is most effective against the bacteria causing the infection.

..... **[1]**

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(iii) Suggest **three** reasons why a hospital might use a multodisc to select the most suitable antibiotic for treating a patient.

.....

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.....

..... **[3]**

(e) Drugs, such as antibiotics, are often first discovered in the natural environment.

Explain why it may become more and more difficult to discover new drugs in the future.

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..... **[2]**

[Total: 20]

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4 **(a)** Amino acids are the basic building blocks for proteins. Fig. 4.1 shows the amino acid cysteine.

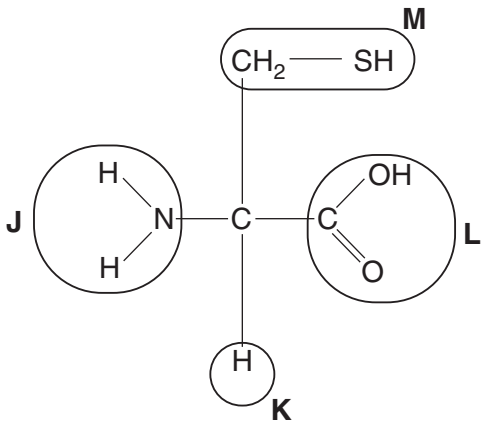


Fig. 4.1

(i) Complete the table by selecting the letter, **J**, **K**, **L** or **M**, that represents the following groups in cysteine.

group	letter
carboxyl	
R group	
amine group	

[3]

(ii) The primary structure of a protein consists of a chain of amino acids.

Describe how a second amino acid would bond to cysteine to form the primary structure of a protein.

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..... **[3]**

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(b) Each amino acid has a different R group.

Describe how these R groups can interact to determine the **tertiary** structure of a protein.

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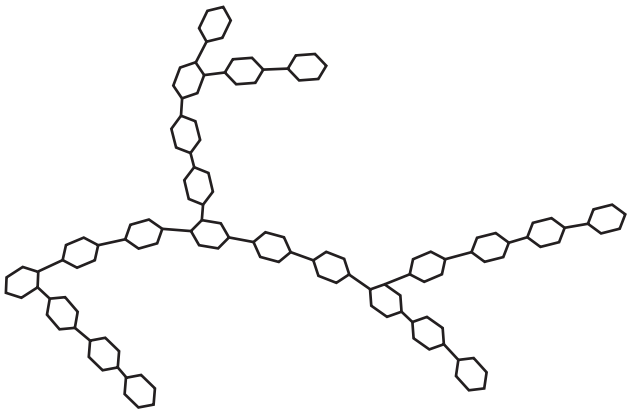
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..... **[4]**

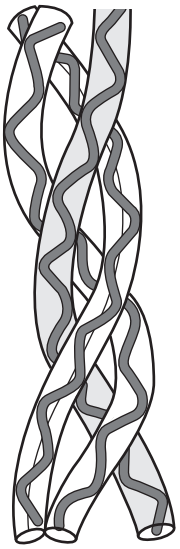
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(c) Fig. 4.2 shows the structure of two polymers, glycogen and collagen, that are found in mammals.



glycogen



collagen

Fig. 4.2

(i) Complete the table below to give three **differences** between the **structure** of glycogen and collagen.

glycogen	collagen

[3]

(ii) Collagen is found in the ligaments which hold bones together at joints.

State **two** properties of collagen that make it suitable for this purpose.

1 .....

2 ..... **[2]**

[Total: 15]

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5 **(a)** Coronary heart disease (CHD) can be described as a multifactorial disease. This means that a number of different risk factors contribute to the development of the disease.

Fig. 5.1 shows the contribution of each risk factor to the percentage of cases of CHD in a population.

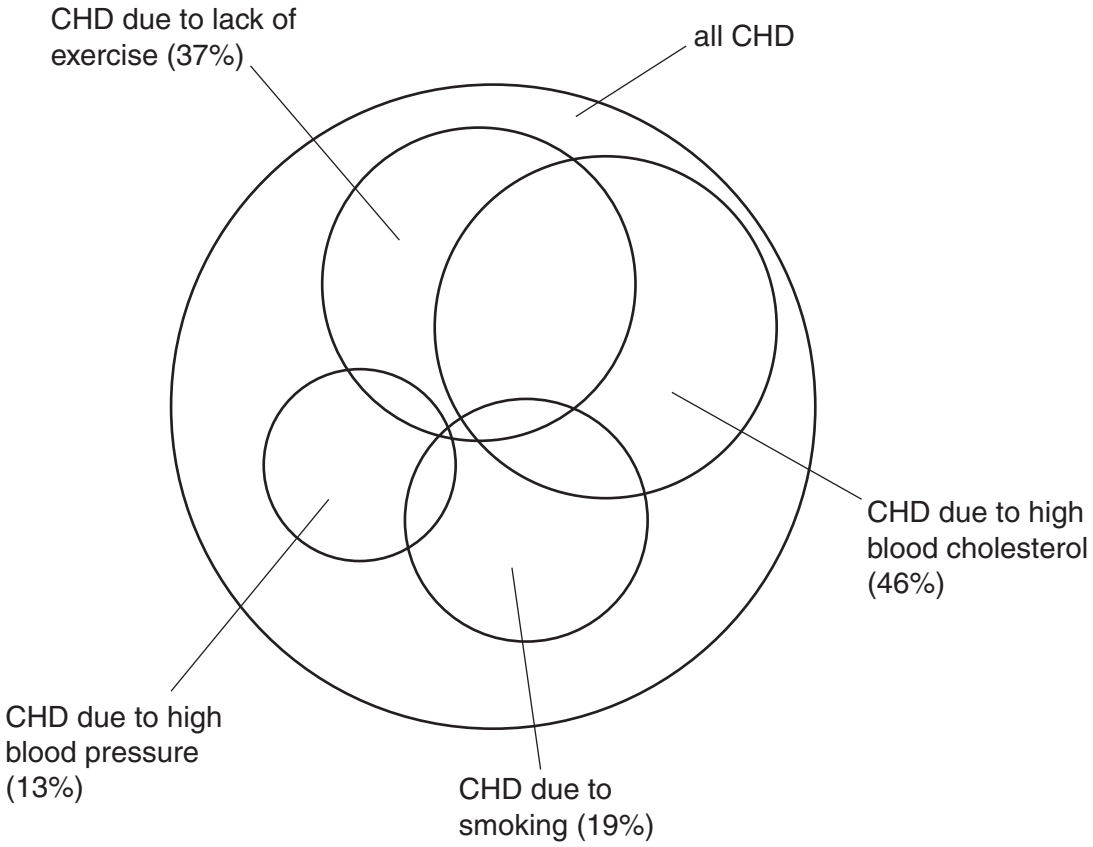


Fig. 5.1

(i) When you add up the different risk factor percentages for the population you find that it is greater than 100%.

Suggest why.

.....

..... **[1]**

(ii) State **two** further risk factors that are **not** shown in Fig. 5.1.

1 .....

2 ..... **[2]**

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(iii) Smoking is a contributing factor in 19% of all cases of CHD.

Table 5.1 lists a number of effects of cigarette smoke.

Use a tick (✓) to indicate which component of cigarette smoke causes each effect.

The first row has been done for you.

Table 5.1

effect	nicotine	carbon monoxide
increases heart rate	✓	
constricts arterioles		
damages the lining of arteries		
reduces the ability of haemoglobin to carry oxygen		
makes platelets sticky		

[4]

(b) Cholesterol is transported in the form of lipoproteins. High levels of low density lipoproteins (LDLs) in the blood are a risk factor in heart disease.

Outline the role of LDLs in the formation of an atheroma.

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.....

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..... **[2]**

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(c) An atheroma can grow to a point where it restricts blood flow in a coronary artery. This causes coronary heart disease (CHD).

Fig 5.2 shows a method of reducing the symptoms of CHD.

A stent is a tubular device containing a 'balloon'. This can be inserted into the damaged artery. The stent can be opened up by inflating the balloon.

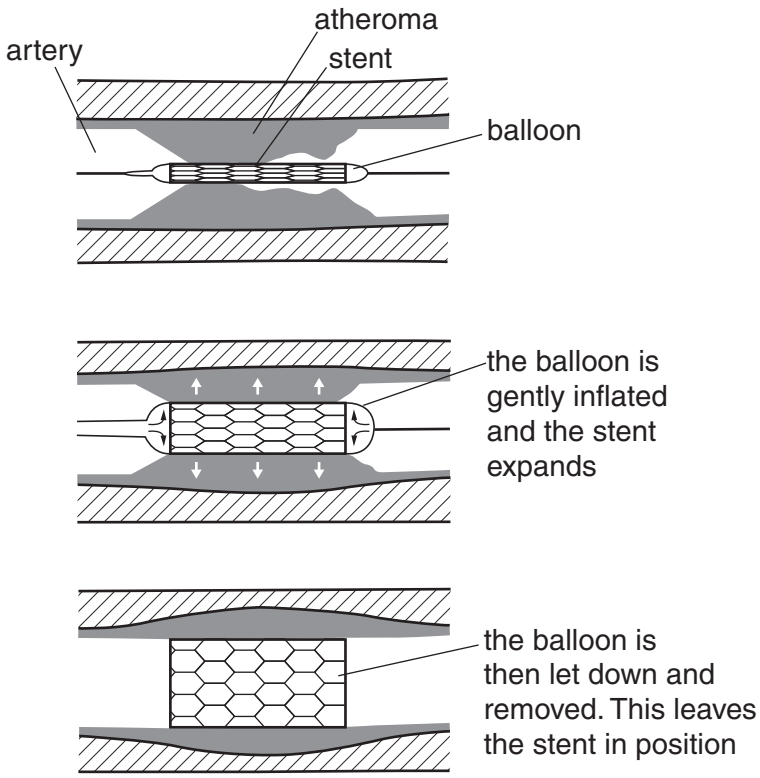


Fig. 5.2

Explain how the inserted stent would reduce the symptoms of CHD.

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..... **[4]**

[Total: 13]

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6 DNA and RNA are nucleic acids.

(a) (i) State the components of a **DNA** nucleotide.

.....

.....

.....

..... **[3]**

(ii) Describe how the structure of RNA differs from that of DNA.

.....

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.....

..... **[2]**

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(b) The DNA needs to be accurately replicated before a cell divides.

Describe how a DNA molecule is replicated.

In your answer you should make clear how the steps in the process are sequenced.

[7]

QUESTION 6(c) STARTS ON PAGE 22

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(c) (i) State what a gene codes for.

.....

.....

..... **[1]**

(ii) Suggest how the final product the DNA codes for can be affected by changing the sequence of DNA nucleotides.

.....

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..... **[2]**

[Total: 15]

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7 Fig. 7.1, **on the insert**, shows a photograph of a part of a heathland habitat. A study was carried out on the biodiversity of this habitat.

(a) Define the terms:

habitat .....

.....

.....

biodiversity .....

.....

..... **[3]**

(b) In this study, a student placed his quadrat on areas he considered to have the most biodiversity.

Explain what is wrong with this technique.

.....

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..... **[2]**

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(c) The student looked at the presence of three plants at different distances from the bottom of the slope.

The results table drawn by the student is shown below.

Table 7.1

distance from bottom of slope	percentage cover of each plant species		
	cotton grass	ling	bracken
0 m	76	0	0
10 m	68	0	0
20 m	0	2	0
30 m	0	35	0
40 m	0	50	0
50 m	0	60	7
60 m	0	40	17
70 m	0	10	42
80 m	0	0	68
90 m	0	0	71
100 m	0	0	74

(i) The format of the student's table is incorrect.

Suggest **one** way in which the student could correct the table.

.....

..... **[1]**

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Fig. 7.2 is a graph showing the distribution of cotton grass and bracken at different distances from the bottom of the slope.

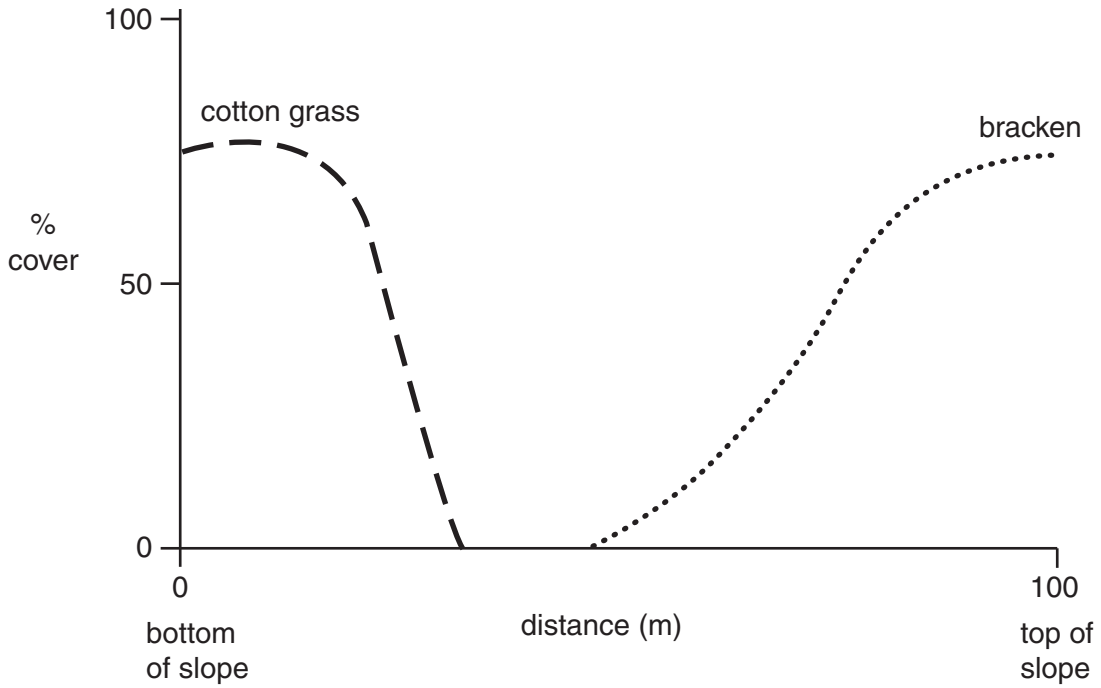


Fig. 7.2

(ii) Use the information in Table 7.1 to **sketch on Fig. 7.2** a curve to show the distribution of **ling**. **[3]**

(iii) Describe the distribution of **bracken**.

.....

.....

.....

.....

..... **[2]**

QUESTION 7(d)(i) STARTS ON PAGE 26

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(d) (i) The student was asked to calculate the biodiversity using Simpson's Index of Diversity.

Suggest what additional data he would need to **collect** in order to calculate Simpson's Index of Diversity in this habitat.

.....

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.....

..... **[2]**

(ii) The student calculated Simpson's Index as 0.2. This is a low value.

State the **significance** of this low value for this habitat.

.....

.....

..... **[1]**

[Total: 14]

END OF QUESTION PAPER

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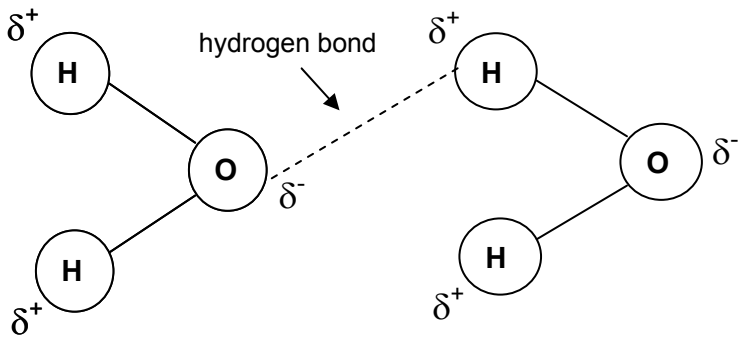
F212 Molecules, Biodiversity, Food and Health

Question			Expected Answers	Marks	Additional Guidance
1	(a)		obese ; iron ; haemoglobin ;	3	
1	(b)		24.7 ; ;	2	If answer incorrect or to the wrong number of dp, then **ALLOW** one mark for working: $69 \div 1.67^2$ 24.74 = one mark **IGNORE** 25 and look for working mark If units are given, they **must** be $kg\,m^{-2}$ (or kg/m^2) Max 1 for incorrect units
1	(c)	(i)	<u>overweight</u> / borderline <u>overweight</u> ;	1	**DO NOT CREDIT** if more than one answer given
1	(c)	(ii)	**1** very close to border / AW ; **2** graph does not distinguish between male and female ; **3** does not measure actual fat / AW ; **4** has, more / less, muscle / bone (than normal) **OR** (does not take into account) muscle / bone, mass / density / weight ; **5** muscle / bone, heavier / denser, than fat / AW ; **6** pregnant ;	2 max	**1 DO NOT CREDIT** mistake reading graph **4** Must refer to idea of amount of muscle / bone being different from normal. **DO NOT CREDIT** muscle / bone unqualified **CREDIT** has osteoporosis as ref. to different bone density

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Question			Expected Answers	Marks	Additional Guidance
1	(d)		**1** coronary heart disease / CHD / atherosclerosis / angina / coronary thrombosis / myocardial infarction / heart attack / cardiac arrest / cardiovascular disease / stroke **;** **2** (osteo)arthritis **;** **3** (Type 2) diabetes **;** **4** high blood pressure / hypertension **;** **5** gallstones **;** **6** cancer **;**	**2 max**	**1 DO NOT CREDIT** heart disease alone / arteriosclerosis **2 DO NOT CREDIT** rheumatoid arthritis **3 DO NOT CREDIT** Type 1 diabetes **6 ACCEPT** any type of cancer
			Total	**10**	

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Question			Expected Answers	Marks	Additional Guidance
2	(a)		**1** hydrogen bond represented as, horizontal / vertical, dashed line between **O** on one molecule and **H** on the adjacent molecule **;** **2** hydrogen / **H**, bond label (on any drawn bond between 2 molecules) **;** **3** (delta positive) δ^+ on **each** drawn **H** **<u>and</u>** (delta negative) (2) δ^- on **each** drawn **O ;**	**3**	 **1** **DO NOT CREDIT** if >1 H bond is drawn between the same two molecules **3** if both molecules drawn, δ^+ and δ^- on **all** atoms. **ACCEPT** d (lower case) for δ

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Question			Expected Answers	Marks	Additional Guidance
2	(b)		*ice floats*		
		P1	(ice less dense because) molecules spread out **;**		
		P2	molecules form, crystal structure / lattice / AW **;**		
		P3	ice forms insulating layer / clearly described **;**		**P3** e.g. acts as a barrier to the cold
		P4	water (below ice), does not freeze / still liquid / remains water / kept at higher temperature **;**		
		S1	organisms do not freeze **;**		**S1 DO NOT ACCEPT** die (because 'survival' stated in stem)
		S2	animals / organisms, can still, swim / move **;**		
		S3	allows, currents / nutrients, to circulate **;**		
			solubility		
		P5	ions / named ion, polar / charged **;**		
		P6	ions /named ion, attracted to / bind to / interact with, water;		
		S4	(named) organisms / plants / animals, uptake / AW, minerals / named mineral / nutrients **;**		**S4 ACCEPT** obtain / enters / goes in / gets
		S5	correct use of named, mineral / nutrient, in organism **;**		**S5** needs to be more specific than 'for growth / metabolism' suitable examples include but are not limited to: nitrates for amino acids / protein / (named) nucleic acid / phosphate for ATP / phospholipids / plasma membrane / magnesium for chlorophyll etc

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			temperature stability		
		P7	many / stable, (hydrogen) bonds between molecules **;**		**P7** Many hydrogen bonds between molecules = 2 marks (gets P7 and H)
		P8	at lot of energy to, force apart molecules / break bonds **;**		**P8** **ACCEPT** heat as alternative to energy
		P9	high (specific) heat capacity **;**		**P9** **DO NOT CREDIT** latent heat capacity
		S6	temperature does not change much / small variation in temperature **;**		**S6** could refer to organisms **or** surrounding water **ACCEPT** stays cool in summer / stays warm in winter **DO NOT CREDIT** constant alone
		S7	effect of temperature on **,** enzymes / metabolic rate **;**		**S7** **ACCEPT** any reference to temperature affecting enzyme activity / metabolic rate
		S8	gases remain soluble **;**		
		H	*Award once in any section* hydrogen bonds **;**	**7 max**	**DO NOT CREDIT** if in incorrect context (e.g. they are strong bonds)
			QWC - Award if you see a P mark **and** an S mark within the **same** section **;**	**1**	Look for the **S** mark first, then award QWC if there is a **P** mark **in the same section** in the mark scheme
2	**(c)**		hydrolysis / hydrolytic **;** hydrophilic **;**	**2**	**ACCEPT** phonetic spelling throughout **IGNORE** head
			Total	**13**	

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Question			Expected Answers	Marks	Additional Guidance
3	(a)	(i)	X ;	1	
3	(a)	(ii)	**1** substrate / PABA, **and**, inhibitor / sulfonamide, similar shape**;** **2** able to, bind / fit into / block, active site **;** **3** (shape) complimentary to active site **;** **4** both have, hex / benzene / 6-C, (ring) **;** **5** both have, NH_2 / amine **;** **6** correct ref to a difference between sulfonamide and PABA **;**	**3 max**	**1 ACCEPT** similar structure **DO NOT CREDIT** same shape **3 DO NOT CREDIT** refs to PABA and sulfonamide being complementary to each other or to the enzyme (alone) **6** e.g. only sulfonamide contains S sulfonamide has 1 more NH_2 group sulfonamide has $SONH_2$ but PABA has N_2 only PABA has COOH group
3	(b)	(i)	*without inhibitor* **1** more, PABA / substrate, molecules enter active site **;** **2** more, enzyme substrate complexes / ESCs, formed **;** **3** at low concentration not all active sites occupied / at high concentration all active sites occupied **;** **4** achieves / reaches, max (turnover) rate / V_{max} **;** **5** (at high substrate concentration) enzyme concentration limiting **;**	**3 max**	**1 ACCEPT** more successful collisions between substrate and active site **3 ACCEPT** active sites filled / no free active sites **DO NOT CREDIT** active sites run out **4 ACCEPT** 'cannot work any quicker' **DO NOT CREDIT** 'optimum rate' or 'rate levels off'

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Question			Expected Answers	Marks	Additional Guidance
3	(b)	(ii)	*with inhibitor* **1** inhibitor / sulfonamide, can, fit / block / bind to / compete for, <u>active site</u> **;** **2** (occupies it) for a short time / temporary / reversibly **;** **3** fewer active sites available (for substrate) / AW **;** **4** (idea of) more substrate reduces chance of inhibitor getting in**;**	**2 max**	**3 ACCEPT** substrate can't access active site **4 ACCEPT** more ESC formed in context of overcoming inhibition / substrate can out-compete inhibitor
3	(c)		**1** mutation **;** **2** sulfonamide is <u>selective</u>, agent / pressure **;** **3** resistant survive / non resistant die **;** **4** (resistance) allele / gene / mutation, passed to, offspring / next generation **;** **5** (happens) over many generations **;** **6** AVP **;**	**4 max**	**DO NOT CREDIT** immune for **any** mark point **3 IGNORE** refs to (survivors) breed / reproduce **;** **5 IGNORE** refs to time. Look for generations **6** e.g. mutation is, **random** / spontaneous allele / gene, passed on by, plasmids / horizontal transmission
3	(d)	(i)	<u>bacteria</u>, killed / destroyed / cannot grow / lyse, in presence of antibiotic **;**	**1**	**DO NOT CREDIT** 'antibiotic works better' **or** 'there are no bacteria there' **or** 'bacteria are broken down'
3	(d)	(ii)	streptomycin **;**	**1**	**IGNORE** '4' as it is the number rather than the name

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Question			Expected Answers	Marks	Additional Guidance
3	(d)	(iii)	**1** cheap / AW **;** **2** (test is) quick to carry out / (deals with several antibiotics) at same time / AW **;** **3** (idea of) allowing early treatment of patient **;** **4** (idea of) compares antibiotics under same conditions **;** **5** (correct antibiotic first time) to prevent antibiotic resistance developing **;**	**3 max**	**DO NOT CREDIT** responses which simply refer to selecting the best antibiotic **2 DO NOT CREDIT** speed of antibiotic action
3	(e)		(new) drugs come from (named) organisms **;** biodiversity is reducing **;** habitats / named habitat, destroyed / lost **;** reason for habitat destruction **;**	**2 max**	**ACCEPT** plants / animals / fungi / species / etc. **ACCEPT** deforestation / natural environment lost e.g. global warming logging fuel crops construction / industrialisation mining fishing pollution tourism **ACCEPT** any other valid reason that will destroy natural habitats but **not** general statements such as 'human development' or 'business'
			Total	**20**	

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Question			Expected Answers	Marks	Additional Guidance
4	(a)	(i)	L ; M ; J ;	3	If 2nd letter given, no mark
4	(a)	(ii)	**1** peptide bond ; **2** between, amine / **J** group (of one amino acid) and carboxyl / **L** group (of another) ; **3** H (from amine group) combines with OH (from carboxyl group) ; **4** condensation reaction **OR** water, lost / eliminated / produced / created / AW ; **5** covalent ;	3 max	**CREDIT** answers from clearly drawn diagrams with bonds labelled **1 ACCEPT** peptide link
4	(b)		**1** some R groups, attract / repel ; **2** disulfide, bridges / bond ; **3** between, cysteine / SH / S (atoms) ; **4** hydrogen / H, bonds ; **5** ionic bonds between, oppositely charged / + and -, R groups ; **6** hydrophilic R groups, on outside of molecule / in contact with water (molecules) ; **7** hydrophobic R groups, on inside of molecule / shielded from water (molecules) ;	4 max	**4 DO NOT CREDIT** in context of **secondary** structure

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<table>
<tr><th colspan="3">Question</th><th>Expected Answers</th><th>Marks</th><th>Additional Guidance</th></tr>
<tr><td>4</td><td>(c)</td><td>(i)</td><td>
<table>
<tr><th></th><th>glycogen</th><th>collagen</th><th></th></tr>
<tr><td>1</td><td>carbohydrate / polysaccharide</td><td>protein / polypeptide</td><td>;</td></tr>
<tr><td>2</td><td>(alpha) glucose (units)</td><td>amino acid (units)</td><td>;</td></tr>
<tr><td>3</td><td>identical units</td><td>different amino acid units</td><td>;</td></tr>
<tr><td>4</td><td>glycosidic, bonds / links</td><td>peptide, bonds / links</td><td>;</td></tr>
<tr><td>5</td><td>branched</td><td>unbranched / linear</td><td>;</td></tr>
<tr><td>6</td><td>non-helical</td><td>helical</td><td>;</td></tr>
<tr><td>7</td><td>one chain (per molecule)</td><td>three chains (per molecule)</td><td>;</td></tr>
<tr><td>8</td><td>no cross links</td><td>cross links (between chains)</td><td>;</td></tr>
<tr><td>9</td><td>contains C H O</td><td>contains C H O N</td><td>;</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table>
</td><td>3 max</td><td>AWARD 1 mark per correct row
Comparative statements must be made in a row

2 DO NOT CREDIT beta

5 ALLOW straight

7 DO NOT CREDIT strands

9 IGNORE S (for collagen)</td></tr>
<tr><td>4</td><td>(c)</td><td>(ii)</td><td>(high tensile) strength / strong ;
does not stretch / is not elastic ;
insoluble ;
flexible ;</td><td>2 max</td><td>Mark the 1st answer on each numbered line
IGNORE fibrous / tough</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>15</td><td></td></tr>
</table>

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Question			Expected Answers	Marks	Additional Guidance
5	(a)	(i)	(diagram shows that some) individuals have more than one risk factor ;	1	**DO NOT CREDIT** CHD is multifactorial
5	(a)	(ii)	**1** high, saturated / animal, fat diet ; **2** high salt intake ; **3** (diet) low in (named) antioxidants / vitamin A / vitamin C / vitamin E ; **4** obesity ; **5** genetic / heredity / inherited / ethnicity / race ; **6** gender / sex ; **7** excess alcohol consumption ; **8** (increasing) age ; **9** diabetes ; **10** stress ;	2 max	Mark the 1st answer on each numbered line. **1 ACCEPT** absence of polyunsaturated fats **7** must indicate, excess / high levels

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<table>
<tr><th colspan="3">Question</th><th>Expected Answers</th><th>Marks</th><th>Additional Guidance</th></tr>
<tr><td>5</td><td>(a)</td><td>(iii)</td><td>
<table>
<tr><th>effect</th><th>nicotine</th><th>carbon monoxide</th></tr>
<tr><td>increases heart rate</td><td>✓</td><td></td></tr>
<tr><td>constricts arterioles</td><td>✓</td><td></td></tr>
<tr><td>damages the lining of arteries</td><td></td><td>✓</td></tr>
<tr><td>reduces the ability of haemoglobin to carry oxygen</td><td></td><td>✓</td></tr>
<tr><td>makes platelets sticky</td><td>✓</td><td></td></tr>
</table>
;
;
;
;
</td><td>4</td><td>DO NOT CREDIT hybrid ticks
IGNORE crosses in the ‘blank’ boxes</td></tr>
</table>

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Question			Expected Answers	Marks	Additional Guidance
5	(b)		**1** damage to endothelium **;** **2** LDLs contain, saturated fat / cholesterol **;** **3** LDLs collect at site of damage **;** **4** fatty substances / cholesterol / LDLs, deposited, in artery wall / under endothelium **;**	**2 max**	**2 DO NOT CREDIT** moves / transports **CREDIT** LDLs are protein **and** saturated fat / cholesterol **3** must be stated **4 ACCEPT** fats / lipids **ACCEPT** under lining of artery wall **DO NOT CREDIT** veins / vessels / capillaries
5	(c)		**1** increases size / AW, of lumen **;** **2** increases / eases / decreases resistance to, blood flow **;** **3** (therefore) more, O_2 / glucose **;** **4** for aerobic respiration **;** **5** in, heart muscle / cardiac muscle / myocardium **;** **6** more CO_2 removed **;**	**4 max**	**1 ACCEPT** reduces blockage in lumen **2 ACCEPT** 'more blood' / 'blood flows more freely' / 'blood flows as normal' / 'quicker blood flow' **3** needs idea of more oxygen (than before operation) **CREDIT** idea of preventing oxygen starvation 'more oxygenated blood' gets mark points 2 and 3
			Total	**13**	

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Question			Expected Answers	Marks	Additional Guidance
6	(a)	(i)	deoxyribose (sugar) ; phosphate (group) ; (nitrogenous / purine or pyrimidine) base / one correctly named base ;	3	**DO NOT CREDIT** dioxyribose **DO NOT CREDIT** phosphate head or phosphate backbone **DO NOT CREDIT** letter instead of named base **DO NOT CREDIT** uracil **DO NOT CREDIT** incorrect spelling of thymine with 'a'
6	(a)	(ii)	has ribose ; uracil / U, instead of, thymine / T ; single stranded ; 3 forms / AW ;	2 max	assume answer refers to RNA unless otherwise stated **DO NOT CREDIT** incorrect spelling of thymine with 'a'

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Question				Expected Answers	Marks	Additional Guidance
6	(b)		1	untwist / unwind ;		1 **DO NOT CREDIT** unravel
		S	2	unzip / described ;		2 **DO NOT CREDIT** strands separating without qualification
		S	3	H bond breaks ;		
			4	both strands act as template ;		
		N	5	(aligning of) free (DNA) nucleotides ;		5 **DO NOT CREDIT** bases
		N	6	complementary, base / nucleotide, pairing ;		6 & 7 Do not consider for **QWC** if mark awarded in the context of breaking apart or DNA structure only, rather than forming new double helix
		N	7	C to G **and** T to A / purine to pyrimidine ;		
		R	8	hydrogen bonds reform ;		
		R	9	sugar-phosphate back bone forms ;		
		R	10	(using) covalent / phosphodiester, bond ;		
			11	semi-conservative replication ;		
			12	DNA polymerase ;		12 **CREDIT** at any stage in the process
			13	AVP ;		13 e.g. ligase / helicase / gyrase used in correct context C – G 3 H bonds / T – A 2 H bonds activation of free nucleotides (with 2 phosphates) synthesis in the 5' to 3' direction Okazaki fragments on lagging strand
					6 max	
				QWC - correct sequence – 1 **S** mark, then 1 **N** mark, then 1 **R** mark ;	1	It should be clear that candidate realises that the sequence is S, then N then R – even if not written in that order **DO NOT CREDIT** if any ref to transcription / translation

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Question			Expected Answers	Marks	Additional Guidance
6	(c)	(i)	polypeptide / protein / primary structure / a sequence of amino acids ;	1	**DO NOT CREDIT** 'codes for an amino acid' **IGNORE** enzyme / named protein
6	(c)	(ii)	different, sequence of amino acids / primary structure / AW ; different protein / protein folds up differently / different tertiary structure ; (product) no longer functions / different function ;	2 max	**DO NOT CREDIT** 'product' or incorrect biochemical (e.g. carbohydrate) **ACCEPT** suitable example, e.g. active site of enzyme no longer complimentary to substrate
			Total	15	

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Question			Expected Answers	Marks	Additional Guidance
7	(a)		*habitat* **1** the place where, an organism / organisms / a population / a community, lives **;** **1 max** *biodiversity* **2** variety of life / the range of living organisms found / AW **;** **3** variety / range, of, habitats / ecosystems **;** **4** number of different species **;** **5** variety / genetic diversity, within species **;** **2 max**	**3 max**	**1** **ACCEPT** animal or plant **ACCEPT** location / environment / area **DO NOT CREDIT** ecosystem ***max 2** for biodiversity* **2** **DO NOT CREDIT** ref to variation **ACCEPT** species richness / species diversity **4** must have ref to number / how many / etc.
7	(b)		not random / should have been random **;** unrepresentative / skewed / biased, results **;** creates an over-estimate of diversity **;** may miss some (dominant) species / does not cover full range of species **;**	**2 max**	**DO NOT CREDIT** ref to 'fair test' unless qualified 'misleading' is not quite good enough **CREDIT** plant / animal instead of species
7	(c)	(i)	remove units from the body of the table **and** put units in column heading / AW **;**	**1**	**ALLOW** 'measurement' or 'type of measurement' instead of 'unit' **DO NOT CREDIT** 'units are not necessary in table'

Question			Expected Answers	Marks	Additional Guidance
7	(c)	(ii)	bell shaped ; peak / highest point, for ling between peaks for bracken and cotton grass (on horizontal axis) ; peak / highest point, for ling lower than both bracken and cotton grass (on vertical axis) ;	3	• must start at 0% cover and after 0m and finish at 0% cover and before 100m • line must cross the line for bracken • allow sharp angle for peak of bell
7	(c)	(iii)	**1** absent at bottom of slope / present at top of slope ; **2** amount of bracken / percentage cover, increases with increasing distance ; **3** comparative figs. with units ;	2 max	**1 DO NOT CREDIT** that bracken is present at top if answer also implies that some bracken is present at the bottom **ALLOW** 'before 40 - 50m' as AW for 'bottom' **ALLOW** 'after 40 - 50m' as AW for 'top' **ALLOW** 'start' instead of 'bottom' and 'finish' or 'end' or 'higher up' instead of 'top' Needs to be stated – cannot be implied from mp 2 **3** two percentages at two stated distances (must be from table) e.g. 0% at 0m and 74% at 100m **or** percentage difference between two stated distances **ALLOW** 'percentage cover' instead of % for units **DO NOT CREDIT** 0% at the bottom and 74% at the top (as no distance has been quoted)

Question			Expected Answers	Marks	Additional Guidance
7	(d)	(i)	record / identify / list / AW, all species / (all) other plants ; (count / estimate) numbers of individuals within each species / AW ;	2 max	**IGNORE** observe **IGNORE** animals *for this habitat* **IGNORE** 'species richness' and any other calculation **ACCEPT** the number of plants / species If the formula is given, only credit this mark if 'n' is explained in terms of the number of individuals within the species
7	(d)	(ii)	not stable / at risk / low ability to withstand change / AW ; more likely to lose species ;	1 max	**IGNORE** 'biodiversity is low' as this is given in the question **IGNORE** 'only a few species' or 'dominated by a few species' as these are descriptions of low biodiversity
			Total	**14**	

THIS IS A NEW SPECIFICATION

OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

BIOLOGY

Molecules, Biodiversity, Food and Health

F212

Candidates answer on the question paper

OCR Supplied Materials:
None

Other Materials Required:
- Electronic calculator
- Ruler (cm/mm)

Monday 1 June 2009
Afternoon

Duration: 1 hour 45 minutes

OCE/13969

F212

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

MODIFIED LANGUAGE

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **100**.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.

Where you see this icon you will be awarded marks for the quality of written communication in your answer.

- This document consists of **20** pages. Any blank pages are indicated.

FOR EXAMINER'S USE		
Qu.	**Max.**	**Mark**
1	**14**	
2	**16**	
3	**18**	
4	**16**	
5	**17**	
6	**19**	
TOTAL	**100**	

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DCA (CW/SHW) OML90606 13969/1

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Turn over

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Answer **all** the questions.

1 **(a)** Complete the following passage by using the most appropriate terms from the list to fill the gaps. Each term should not be used more than once.

anti-parallel	**β-pleated sheet**	**covalent**
double helix	**hydrogen**	**parallel**
polypeptide	**ribose**	**sugar-phosphate**

DNA is found in the nucleus. The molecule is twisted into a .... in which each of the strands are ..... . It has two ..... backbones attached to one another by complementary bases. These bases pair in the centre of the molecule by means of ..... bonds. **[4]**

(b) Table 1.1 shows the relative proportions of different DNA bases in four different organisms.

Table 1.1

	relative proportions of bases in DNA as a percentage			
organism	A	C	G	T
human	30.9	19.8	19.9	29.4
grasshopper	29.3	20.7	20.5	29.3
wheat	27.3	22.8	22.7	27.1
E. coli	24.7	25.7	26.0	23.6

(i) Describe the patterns shown by the data given in Table 1.1.

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..... **[3]**

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(ii) Suggest how the data given in Table 1.1 might have been helpful to scientists in working out the structure of DNA.

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..... **[2]**

(c) DNA in the nucleus acts as a template for the production of RNA.

Complete the table below to show **three** ways in which the structure of DNA differs from that of RNA.

feature	DNA	RNA
number of strands		
bases present		
sugar present		

[3]

(d) DNA codes for the structure of polypeptides.

State the role of messenger RNA (mRNA).

.....

.....

.....

.....

..... **[2]**

[Total: 14]

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2 Malaria kills over one million people every year. The vast majority are under the age of ten.

Adults who have survived malaria in childhood and then continue to live in an area where malaria is found, develop a limited form of immunity.

(a) (i) Name the parasite that causes malaria.

..... **[1]**

(ii) Name the vector for the malarial parasite.

..... **[1]**

(iii) Name a human cell in which the malarial parasite reproduces.

..... **[1]**

(b) Scientists are developing a vaccine using an attenuated (inactive) form of the malarial parasite.

The aim is to trigger an immune response without the development of the disease.

Describe the actions of the **B lymphocytes** in the immune response.



In your answer you should make clear how the steps in this part of the immune response are sequenced.

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..... **[8]**

(c) Suggest why adults who have survived malaria may lose their immunity when they **leave** a malarial area.

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..... **[2]**

(d) State **three biological** reasons why it has not been possible to produce an effective vaccine for malaria.

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..... **[3]**

[Total: 16]

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3 In the search for new biofuels, research has been done into the digestion of wood waste by fungi.

The fungi produce cellulase enzymes that break cellulose into sugars. These sugars can then be converted into ethanol, a biofuel.

Fig. 3.1 shows the stages in this digestion process.

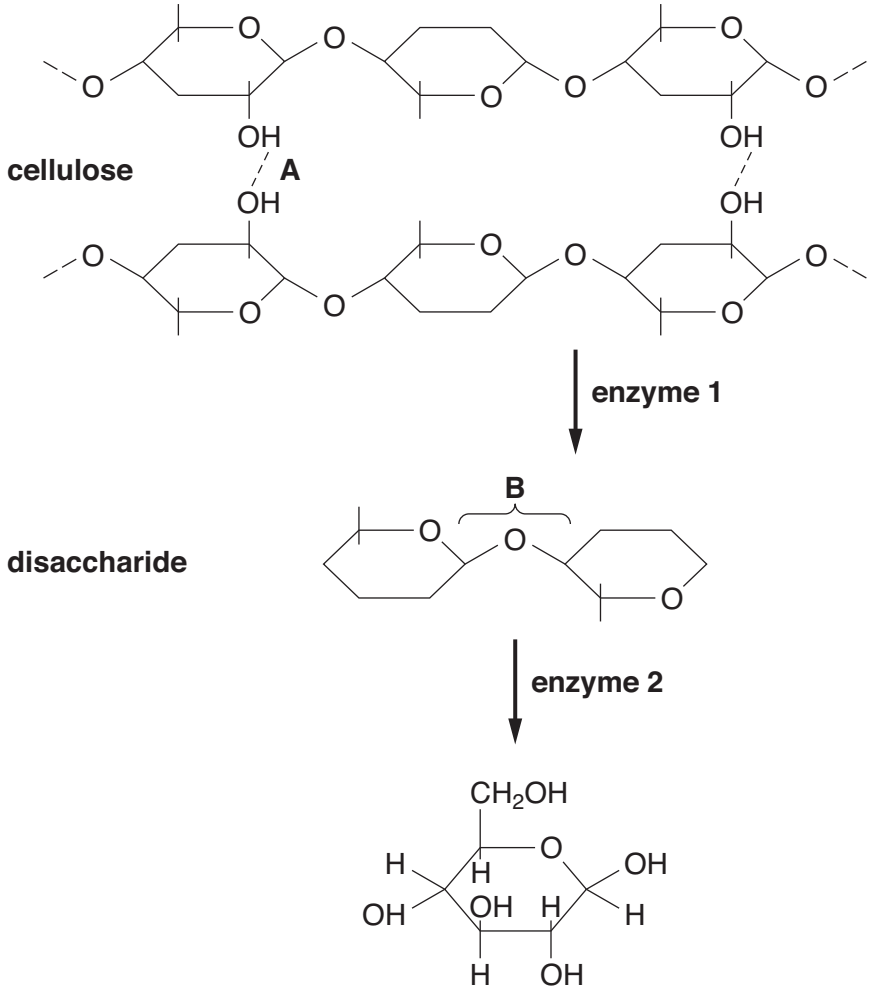


Fig. 3.1

(a) (i) Name bonds **A** and **B** shown in Fig. 3.1.

A .....

B ..... **[2]**

(ii) State how bond **B** is broken in the digestion of the disaccharide.

.....

..... **[1]**

(iii) Name the sugar that is the **final** product of this digestion process.

..... **[1]**

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(b) Explain why **different** enzymes are involved in each stage of the digestion process.

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..... **[3]**

QUESTION 3 CONTINUES ON PAGE 8

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(c) Fig. 3.2 shows the effect of changing pH on the rate of activity of **enzyme 2**.

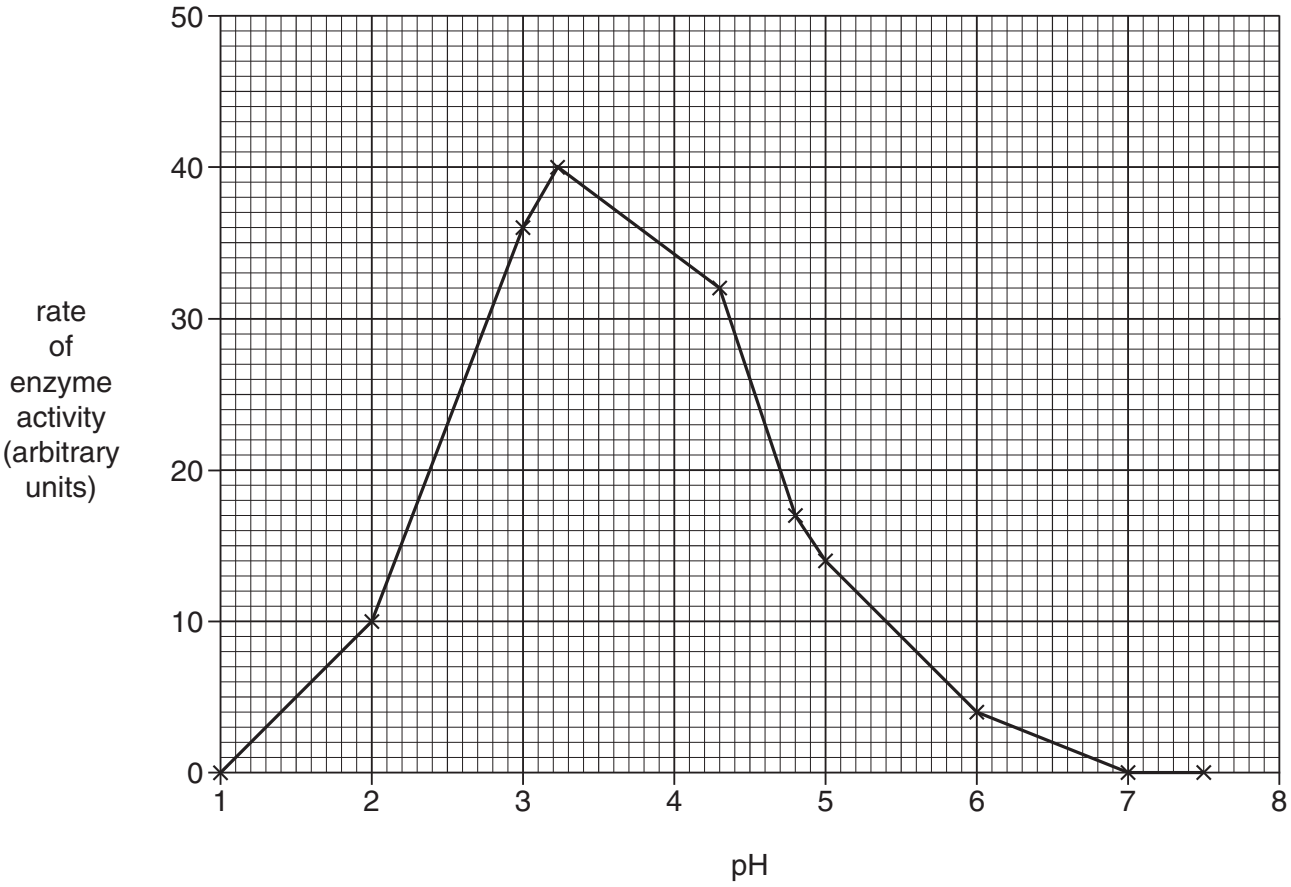


Fig. 3.2

(i) Explain why the activity of **enzyme 2** falls to zero at pH 7.

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..... **[3]**

(ii) State **two** factors that should have been controlled when investigating the effect of pH on the activity of **enzyme 2**.

1 .....

2 ..... **[2]**

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(d) The activity of an enzyme can be measured by testing for the concentration of its product at regular intervals.

Describe how the concentration of a reducing sugar can be measured using a colorimeter.

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..... **[6]**

[Total: 18]

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4 The population of the white-backed vulture, *Gyps bengalensis*, in India has fallen by 97% to an estimated 4 000 vultures. This vulture is now considered to be 'critically endangered'. Reasons for the decline in numbers include:

- vultures feed on carcasses including those from farm animals.
- these farm animals may have been treated with a pain killer. This particular pain killer causes kidney failure in the vultures.
- the use of this pain killer is being phased out. However, many farmers continue to use up their stocks of the drug.
- this pain killer is not easily biodegradable and will remain in the environment for many years.

(a) (i) Suggest what is meant by *critically endangered*.

.....

..... **[1]**

(ii) Calculate the **original** population of the white-backed vulture.

Show your working.

Answer = ... **[2]**

(b) A captive breeding programme has been set up in an effort to save the white-backed vulture.

Three centres in India have been built, each housing up to 40 individuals. These vultures have been collected from different areas of the Indian subcontinent.

(i) Explain why the decision was made to conserve the species in captivity (*ex situ*) rather than in the wild (*in situ*).

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..... **[4]**

(ii) Explain why the white-backed vultures in the captive breeding programme were,
- collected from several different areas
- housed in three separate centres.

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..... **[3]**

(c) Outline **three** reasons why the conservation of the white-backed vulture is important.

1 .....

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2 .....

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3 .....

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..... **[3]**

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(d) Once the captive bred individuals have been released into the wild, suggest **three** measures that could be taken **in the long term** to preserve the numbers of white-backed vultures.

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..... **[3]**

[Total: 16]

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5 **(a)** Fig. 5.1 shows a section of a leaf from a pear tree that is infected by the mildew fungus.

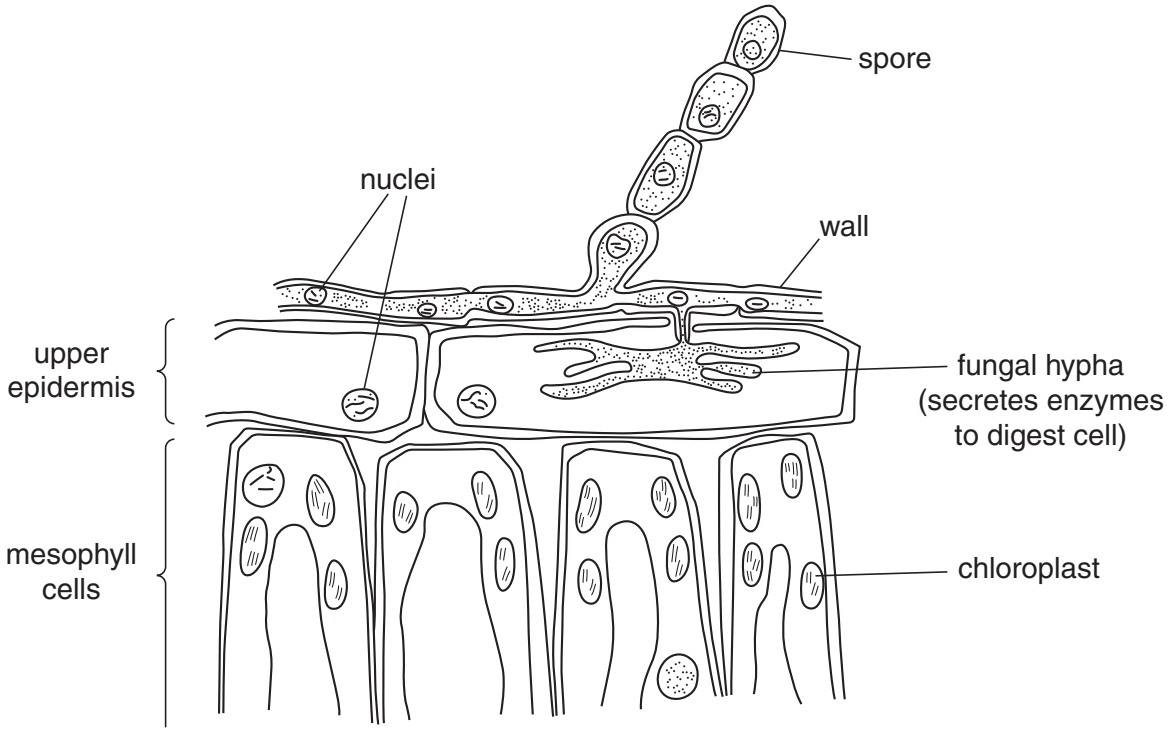


Fig. 5.1

(i) State **one** feature, **shown in Fig. 5.1**, that excludes **both** the pear tree and mildew from the kingdom Prokaryotae.

.....

..... **[1]**

(ii) State **two** reasons why mildew should be placed in the kingdom Fungi.

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..... **[2]**

(iii) State **two** reasons why the pear tree should be placed in the kingdom Plantae.

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..... **[2]**

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(iv) Name **two** kingdoms other than Prokaryotae, Fungi and Plantae.

1 .....

2 ..... **[2]**

(b) The mildew fungus also infects wheat plants, causing disease.

- Most wheat plants in the UK show little resistance to this disease.
- Some Iranian wheat plants are resistant.
- The yield from these resistant wheat plants is very low.

(i) An investigation into the resistance of the Iranian wheat plants to mildew produced the results shown in Fig. 5.2.

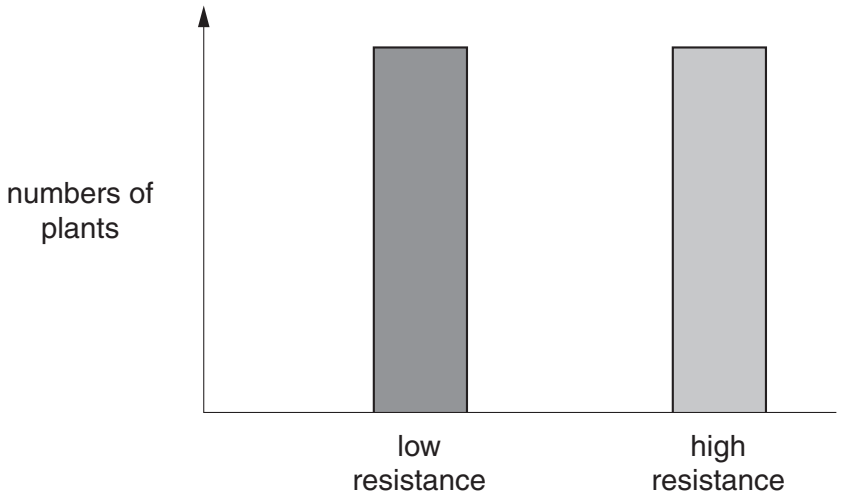


Fig. 5.2

State the type of variation that is shown in Fig. 5.2 **and** describe its characteristics.

type of variation .....

characteristics of this type of variation

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..... **[3]**

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(ii) Outline how a breeding programme could be carried out to produce wheat plants which have both high yield **and** resistance to mildew.

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..... **[3]**

(c) Over a period of time, mildew can overcome the resistance bred into the wheat.

Use the theory of natural selection to explain how the mildew fungus adapts to overcome this resistance.

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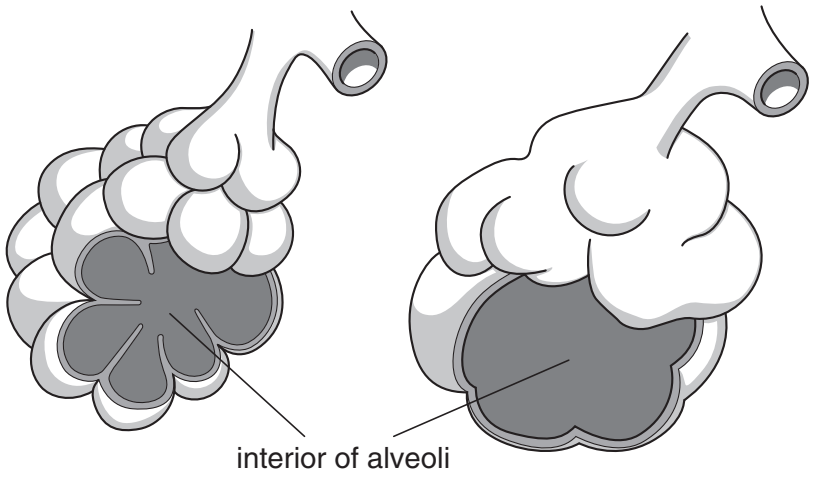
..... **[4]**

[Total: 17]

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6 **(a)** Fig. 6.1 shows a diagram of alveoli in a healthy lung and alveoli in a lung from a person with advanced emphysema.



alveoli in a healthy lung alveoli from a person with advanced emphysema

Fig. 6.1

(i) Describe how smoking could cause changes in alveoli, such as those shown in Fig. 6.1.

In your answer you should make the links between the changes and their causes clear.

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..... **[6]**

(ii) Emphysema is a form of chronic obstructive pulmonary disease (COPD).

Describe **two** signs or symptoms of emphysema.

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..... **[2]**

(iii) Emphysema is described as a chronic disease.

Suggest the meaning of the term *chronic*.

.....

.....

..... **[2]**

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(b) An investigation was conducted into the effect of smoking on lung function. One measure of lung function is peak flow rate.

The peak flow rate is the maximum volume of air expelled from the lungs in one minute ($dm^3\ min^{-1}$).

Two male volunteers, one a smoker and one a non-smoker, had their peak flow measured once a year for seven years.

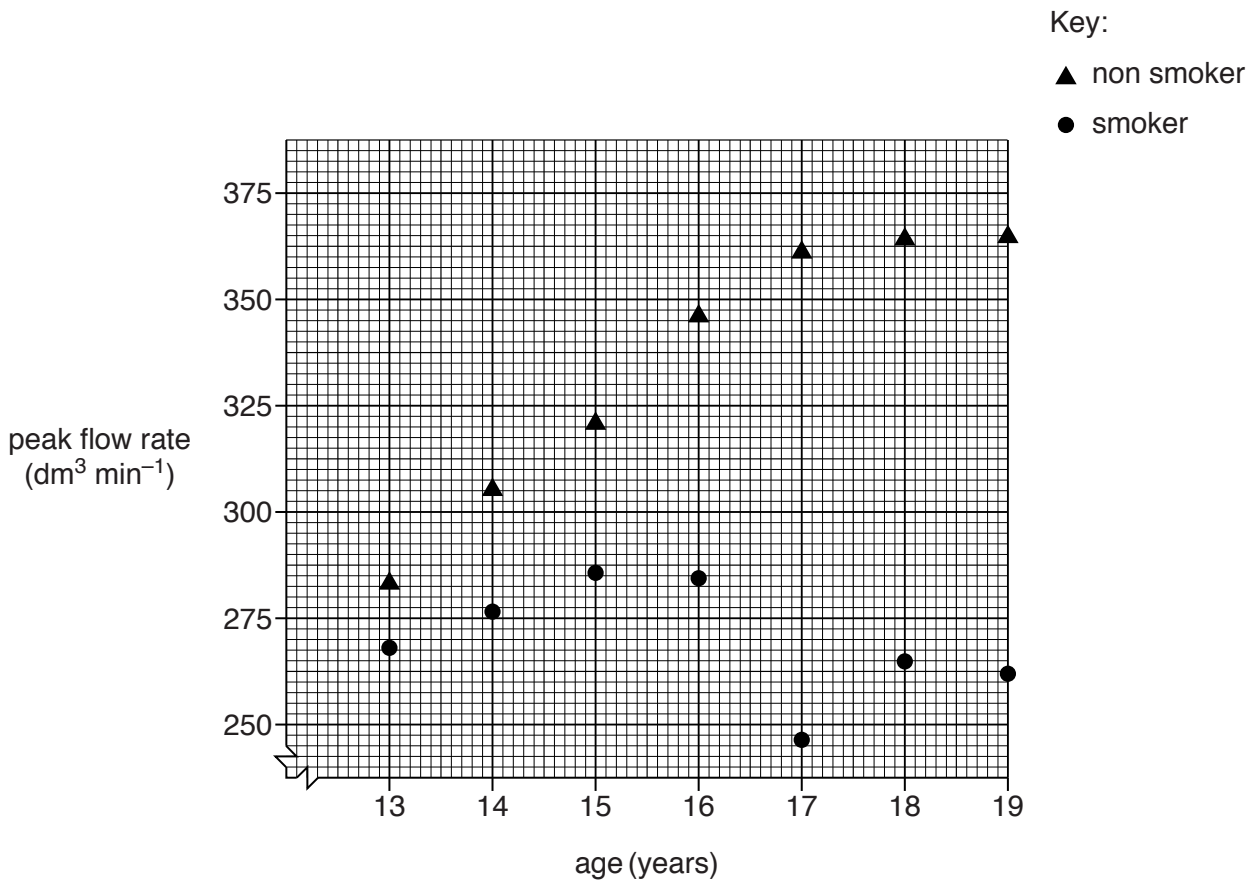


Fig. 6.2

(i) **Describe** the data shown in Fig. 6.2.

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..... **[4]**

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(ii) **Explain** the results obtained for the smoker.

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..... **[2]**

(iii) Suggest **three** ways of improving the reliability of this investigation.

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..... **[3]**

[Total: 19]

END OF QUESTION PAPER

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F212 Molecules, Biodiversity, Food and Health

Question			Expected Answers	Marks	Additional Guidance
1	(a)		double helix ; anti-parallel ; sugar-phosphate ; hydrogen ;	4	
1	(b)	(i)	percentages / amount , C & G similar (in all organisms) ; percentages / amount , A & T similar (in all organisms) ; different / named , organisms have different proportions of , bases / named base / AW ; greatest similarity between human and grasshopper ; least similarity between *E coli* and the other three ; *E. coli* has similar proportions of all bases / *E.coli* has slightly more CG than AT / (named) eukaryote has more AT than CG ; comparative figs with units to support any statement ;	3 max	mp 1 & 2 **DO NOT CREDIT** ref to a single organism mp 1 & 2 **IGNORE** ref to complementary **DO NOT CREDIT** statements in context of organism size e.g. statement that human has more A than *E. coli* / human has the most AT / *E. coli* has the most CG This mark is for a general statement e.g. human C = 19.8 % and G = 19.9 % human A = 30.9 % and *E. coli* A = 24.7 % 'human has more A (30.9%) than wheat (27.3%)' **= 2** (mp 3 & 7)

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Question			Expected Answers	Marks	Additional Guidance
1	(b)	(ii)	(suggests) A , bonds / pairs / links / connects / joins , to T ; (suggests) C , bonds / pairs / links / connects / joins , to G ; (suggests) purine bonds to pyrimidine ; (evidence for) complementary base pairing / which bases pair with each other / base pairing rules ; suggests bases point 'inwards' rather than 'outwards' ;	2 max	**IGNORE** A – T or A = T unqualified **IGNORE** C – G or C = G unqualified **ACCEPT** 'bond' instead of 'pair'

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<table>
<tr><th colspan="3">Question</th><th>Expected Answers</th><th>Marks</th><th>Additional Guidance</th></tr>
<tr><td>1</td><td>(c)</td><td></td><td>Award 1 mark per correct row

<table>
<tr><th>feature</th><th>DNA</th><th>RNA</th><th></th></tr>
<tr><td>number of strands</td><td>two / double</td><td>one / single</td><td>;</td></tr>
<tr><td>bases present</td><td>thymine / T
(+ adenine
+ cytosine
+ guanine)</td><td>uracil / U
(+ adenine
+ cytosine
+ guanine)</td><td>;</td></tr>
<tr><td>sugar present</td><td>deoxyribose</td><td>ribose</td><td>;</td></tr>
</table></td><td>3</td><td>If a choice of answers is given, do not credit unless both answers are valid (e.g. two and double strands for DNA / ribose and pentose sugar)

ACCEPT letters instead of names of bases
Names of bases must be unambiguous, so
DO NOT CREDIT adenosine / thiamine / cysteine / etc.
If more bases mentioned than T and U, then all bases must be included

DO NOT CREDIT dioxyribose / oxyribose/ hexose / sugar
IGNORE pentose</td></tr>
<tr><td>1</td><td>(d)</td><td></td><td>carries / transfers, the (complementary DNA) ,
code / genetic information / copy of gene ;
out of the nucleus ;
(transfers it) to the, ribosome / RER / site of translation ;
for, protein / polypeptide, synthesis ;</td><td>2 max</td><td>IGNORE transcription
DO NOT CREDIT ref to the whole DNA code / molecule

ACCEPT ‘to make protein’</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>14</td><td></td></tr>
</table>

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Question			Expected Answers	Marks	Additional Guidance
2	(a)	(i)	<u>*Plasmodium*</u> ;	1	Look for correct spelling of generic name but do not penalise the use of lower case initial letter. We are not looking for specific name(s), so **IGNORE** species name. So e.g. *Plasmodium falciparum* should be credited but **NOT** *P. falciparum* / *P. vivax* / *P. ovale* / *P. malariae*
2	(a)	(ii)	<u>female</u> *Anopheles* ;	1	**CREDIT** phonetic spelling but genus must be correct
2	(a)	(iii)	hepatocyte / liver (cell) ; erythrocyte / red blood (cell) ;	1 max	If a choice of answers is given do not credit unless both are valid. **DO NOT CREDIT** 'RBC' as this is not a name

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Question			Expected Answers	Marks	Additional Guidance
2	(b)	1	humoral response ;		
		2	(B) cell / lymphocyte , has antigen receptor / carries antibody on its surface ;		
		3	specific to / matches / complementary to , only one antigen ;		
		4	clonal selection ;		
		5	selection / activation , of , appropriate / specific , B lymphocyte / B cell ;		
		6	by , macrophages / antigen presenting cells / dendritic cells / T helper cells / cytokines / interleukins ;		
		7	clonal expansion ;		
		8	(selected cell) divides by mitosis / clones ;		
		9	(B) cells , differentiate / specialise ;		
		10	(B cells) form , plasma / effector , cells ;		
		11	(which) secrete / produce , antibodies ;		**ACCEPT** 'forms antigen-antibody complex'
		12	antibodies are , specific / complementary , to antigen ;		
		13	(B cells) form memory cells ;		
		14	**Either** (memory cells) long-lived / remain in circulation / remain in body / provide immunological memory **or** (provides) secondary response **or** faster / stronger , response to subsequent exposure (of same antigen / pathogen / parasite) ;	**7 max**	**DO NOT CREDIT** ref to disease alone
			QWC ~ correct sequence ;	**1**	Clonal selection, then clonal expansion, then differentiation (stages named or described) Use the QWC tool to indicate these in the correct sequence and add 1 mark to the 7max for content when **all 3** stages have been addressed in the correct sequence.

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Question			Expected Answers	Marks	Additional Guidance
2	(c)		*Assume that candidates are answering in terms of a person <u>leaving</u> the malarial area (unless otherwise stated).* no repeat infections / no further exposure (to antigen / pathogen / parasite) **;** no booster / lose immunological memory **;** limited life for memory cells / numbers of memory cells reduce / memory cells lost **;** so no **,** secondary response / secondary response described **;**	**2 max**	**DO NOT CREDIT** disease / malaria / bacterium / virus ***CREDIT*** *converse points if they answer the question in the context of a person <u>staying</u> in the malarial area.* *e.g. repeat infections **;*** *maintain immunological memory **;*** *memory cells present **;*** *secondary response available **;***

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Question			Expected Answers	Marks	Additional Guidance
2	(d)		different , strains / species / types (of *Plasmodium*) ; different antigens ; due to , mutation / variation ; more than one stage in the life cycle (within human) ; different stages have different antigens ; so will need , a different vaccine / components of vaccine , for each , strain / stage ; (parasite) concealed / hidden , in cells ; (parasite) only , exposed / in circulation , for short time ; AVP ;	3 max	**DO NOT CREDIT** 'disease' or 'malaria' unqualified **Max 2** if they think it is a virus / bacterium 'different strains will require different vaccines' **= 2** (mp 1 & 6) **CREDIT** antigenic concealment e.g. antigenic , shift / drift eukaryotes have greater capacity for variation antigens (on parasite) change over time when in human
			Total	**16**	

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Question			Expected Answers	Marks	Additional Guidance
3	(a)	(i)	**A** hydrogen ; **B** glycosidic ;	2	**DO NOT CREDIT** 'H bond' as this is not a name Correct spelling only. **IGNORE** α or β or numbers
3	(a)	(ii)	hydrolysis / addition of water ;	1	
3	(a)	(iii)	β / beta , glucose ;	1	Must be qualified as β or beta or B or b
3	(b)		enzymes are specific ; the , carbohydrate molecules / substrates , are different shapes ; active site and substrate are complementary ; so that substrate will fit / formation of ESC ; lock and key / induced fit ;	3 max	

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Question			Expected Answers	Marks	Additional Guidance
3	(c)	(i)	pH much , higher / less acidic , than optimum (for enzyme 2) ; change in charge of active site ; hydrogen / ionic , bonds break ; tertiary structure / 3D shape / active site shape , altered ; enzyme / tertiary structure , denatured ; substrate no longer fits active site / ESC does not form ;	3 max	Needs idea of much greater or too high **DO NOT CREDIT** just 'higher than' or 'above' **DO NOT CREDIT** too / more , alkaline **DO NOT CREDIT** peptide / disulphide , bonds break **DO NOT CREDIT** in context of heat / vibration **IGNORE** ref to denaturing active site **IGNORE** ref to denaturing active site **DO NOT CREDIT** kill / die 'substrate doesn't bind to enzyme' is not quite enough
3	(c)	(ii)	*Mark 1st response on each numbered line unless no answer on one line, then mark 1st 2 answers* temperature ; substrate concentration ; enzyme concentration ;	2 max	**IGNORE** ref to time

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Question			Expected Answers	Marks	Additional Guidance
3	(d)		***Marking points 2 – 6 can be applied to the standard solutions or the sample***		
		1	using , standard / known , concentrations (of reducing sugar) ;		e.g. serial dilutions
		2	heat with , Benedicts (solution) / $CuSO_4$ + NaOH ;		**ALLOW** boil / > 80^oC **DO NOT CREDIT** warm
		3	(use of) same volumes of solutions (each time) ;		**DO NOT CREDIT** amount / quantity
		4	(use of) excess Benedicts ;		
		5	changes to , green / yellow / orange / brown / (brick) red ;		
		6	remove precipitate / obtain filtrate ;		**CREDIT** description of method e.g. filtering / centrifuging & decanting
		7	calibrate / zero , colorimeter ;		
		8	using , a blank / water / unreacted Benedicts ;		
		9	use (red) filter ;		
		10	reading of , transmission / absorbance ;		**ACCEPT** 'measure how much light , does / does not , pass through'
		11	more transmission / less absorbance , of filtrate = more sugar present ; **ora**		If precipitate is **clearly indicated** as being present in sample, **ALLOW** 'less transmission / more absorbance , = more sugar present'
		12	(obtain) calibration curve ;		
		13	plotting , transmission / absorbance , against (reducing) sugar concentration ;		
		14	use reading of unknown sugar solution and read off graph to find conc. ;	**6 max**	
			Total	**18**	

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Question			Expected Answers	Marks	Additional Guidance
4	(a)	(i)	likely to become extinct / on the verge of extinction / numbers are not sustainable / numbers too low for survival of species / numbers drop below 10% of (original) population ;	1	**DO NOT CREDIT** 'may' / 'might' / 'could' become extinct **CREDIT** 'die out' or 'wiped out' instead of extinct
4	(a)	(ii)	133 333 ; ;	2	Award 2 marks for a correct answer, even if no working shown. **ALLOW** 1 mark for seeing 133 333.3333... if answer is incorrectly rounded or not rounded to a whole number. If the answer is incorrect **ALLOW** 1 mark for $\frac{4000 \times 100}{3}$
4	(b)	(i)	painkiller still being used ; *in captivity – allow reverse argument for in the wild* fed uncontaminated food / keep away from painkiller ; health of individuals monitored / treated for disease ; eggs (artificially) incubated / young hand reared ; reduced mortality of young ; provision of mate / females breeding can be manipulated ; protection , from hunting / predation ; competition reduced (between , individuals / species) ;	4 max	**IGNORE** ref to controlling diet or nutrition e.g. hormones / artificial insemination / artificial selection 'safer environment' is not quite enough

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Question			Expected Answers	Marks	Additional Guidance
4	(b)	(ii)	maintain / increase **,** genetic variation / gene pool **;** reduce risk of **,** inbreeding / breeding between related birds **;** different 'races' of vulture in different areas / geographical variation / different subspecies **;** less likely **all** contaminated with painkiller **;** less risk of losing all individuals due to **,** disease / natural disaster / human action **;**	**3 max**	In the context of the vultures**,** rather than 'biodiversity' **CREDIT** different alleles **DO NOT CREDIT** different genes **CREDIT ora** for idea of promoting outbreeding **ALLOW** ref to types of (white-backed) vulture
4	(c)		reason **or** explanation **; ; ;** *Suitable examples include but are **not** limited to:* • maintains biodiversity • part of food chain / part of ecosystem / part of food web / scavengers • have a right to existence / moral reason • specific religious reason • give pleasure / beautiful creatures • ecotourism • useful product / source of medicine / medical research • genetic resource • saves clearing up / remove carcasses • prevents disease • keeps **,** rat / dog **,** population down	**3**	**CREDIT any three valid suggestions**. *Ignore the numbers on the answer lines.* *Mark as prose and award points as they arise.* The idea of research must be qualified

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Question			Expected Answers	Marks	Additional Guidance
4	(d)		ban / make illegal , use of **this** painkiller ; provide alternative painkillers (that do not have the same ecological impact) ; no hunting / no killing / legal protection , of white-backed vultures ; protected areas / sanctuary / reserves ; provide breeding sites ; prevent habitat destruction ; monitoring (of vultures) / tagging ; feeding programme (for released birds) / provide uncontaminated carcasses ; qualified ref. to education ; promotion of ecotourism ; in case the population falls again , sperm and egg banks / frozen embryos ;	**3 max**	e.g. to farmers / local people (on importance of vultures)
			Total	**16**	

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Question			Expected Answers	Marks	Additional Guidance
5	(a)	(i)	nucleus / nuclei ;	1	*If more than 1 answer given = 0*
5	(a)	(ii)	*mildew ...* (usually) chitin / not cellulose (cell) , wall ; external digestion / secretes enzymes externally ; heterotrophic / saprophytic / saprotrophic / saprobiont ; no , plastids / chloroplasts / amyloplasts ; spores ; hyphae / mycelium ; multi-nucleate / coenocytic / aseptate ;	2 max	*If 1st statement INCORRECT, max 1* Must be external or outside or equivalent **CREDIT** syncytium / syncytial
5	(a)	(iii)	*pear tree ...* cellulose cell walls ; multicellular ; has , chloroplasts / plastids / chlorophyll / photosynthetic pigment ; (photo)autotrophic / performs photosynthesis ;	2 max	*If 1st statement INCORRECT, max 1* **IGNORE** any references to vacuoles or other organelles 'makes its own food' is not enough
5	(a)	(iv)	Prot**oct**ista / Prot**oct**ist(s) ; Animalia / animal(s) ;	2	**CREDIT** in either order **DO NOT CREDIT** Protista / Protist *look for the **'c'***

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Question			Expected Answers	Marks	Additional Guidance
5	(b)	(i)	discontinuous ; single / few , genes ; qualitative ; discrete categories / either low or high resistance / no intermediates ; no / small / little , environmental effects ;	1 2 max	**CREDIT** at any point in the answer **IGNORE** genetic **CREDIT** a description of **discontinuous** variation (to max 2) even if the type of variation given is incorrect. **CREDIT** 'large / only , genetic effect'
5	(b)	(ii)	artificial selection / selective breeding ; cross / breed , Iranian / resistant , wheat with , high yield / UK , wheat ; method to prevent self , pollination / fertilisation ; select , best offspring / offspring with good yield and resistant ; (back) cross to high yield (UK) wheat / interbreed best offspring / interbreed offspring with both characteristics ; idea of breeding (and selecting) for many generations ;	 3 max	**IGNORE** country incorrectly linked to characteristic as long as the correct cross has been described e.g. removing anthers / bag stigma

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Question			Expected Answers	Marks	Additional Guidance
5	(c)		genetic variation ; (due to) mutation ; (mutation is) spontaneous / random / pre-existing ; (due to) sexual reproduction ; mildew fungus produces large numbers of , spores / gametes / offspring ; wheat resistance acts as a selection pressure ; (individuals that overcome resistance) have selective advantage / are more likely to survive ; pass on , mutation / (mutated) allele (to offspring) ; increase in allele frequency (of allele to overcome resistance) ;	4 max	**IGNORE** 'survival of the fittest' as this is not an explanation **CREDIT ora** for those with selective disadvantage **ALLOW** gene **DO NOT CREDIT** characteristic / ability
			Total	**17**	

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